STAR

SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

FEBRUARY 8, 1971

VOLUME 9 • NUMBER 3

N71-12201—N71-13400

PUBLIC DOCUMENTS

FEB 22 1971

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D. C., 20402, United States of America.

Semimonthly issues...

Annual subscription rate: $54, domestic; $68.25, foreign. Price per single copy: $2.25, domestic; 25% extra for foreign mailing.

Cumulative index issues...

Annual subscription rate: $30, domestic; $35, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates...

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates...

Apply to Argentina, Brazil, French Guiana, Guyana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION OFFICE

Scientific and Technical Aerospace Reports, Volume 9, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Tisco, Inc.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

INTRODUCTION

A COMPREHENSIVE INFORMATION SERVICE

The National Aeronautics and Space Administration makes the results of worldwide research and development activities in aeronautics, space, and supporting disciplines promptly available to participants in its programs. NASA's scientific and technical information system now contains nearly a million documents, which are abstracted, indexed, and obtainable through retrieval and dissemination services. These services, which include this abstract journal, *Scientific and Technical Aerospace Reports (STAR)*, are described fully in a bulletin, *The NASA Scientific and Technical Information System . . . and How to Use It*, available at no charge from the NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, Maryland 20740.

STAR—A REPORT ABSTRACTING SERVICE

STAR is a comprehensive abstracting and indexing journal covering current worldwide *report* literature on the science and technology of space and aeronautics. Publications abstracted in *STAR* include scientific and technical reports issued by NASA and its contractors, other U.S. Government agencies, and corporations, universities, and research organizations throughout the world. Pertinent theses, NASA-owned patents and patent applications, translations, and other separate documents are also abstracted. Citations and abstracts in *STAR* are grouped in 34 subject categories. Six indexes are included in each issue: subject, personal author, corporate source, contract number, report/accession number, and accession/report number. Cumulative index volumes are published semiannually and annually.

STAR, which is issued on the 8th and 23rd of each month, is available to the public on subscription from the Superintendent of Documents, U.S. Government Printing Office, as noted on the inside cover. *STAR* is sent without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants;
2. Other U.S. Government agencies and their contractors;
3. Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public use;
4. Other organizations in the United States having a need for NASA documents in work related to the aerospace program; and
5. Foreign government or academic organizations that have established appropriate reciprocal arrangements with NASA.

Those eligible to receive *STAR* without charge should address their requests to the NASA Scientific and Technical Information Facility.

ABSTRACTS OF NON-REPORT LITERATURE

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts (IAA)* provides parallel coverage of scientific and trade journals, books, and conference papers in the same subject areas as the reports abstracted in *STAR*. *STAR* and *IAA* are categorized and abstracted in basically identical ways, and documents in both are indexed by terms from the *NASA Thesaurus*. Both journals appear twice monthly. *IAA* is issued on the 1st and 15th of each month.

IAA is available on subscription from the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York, 10017, at the following annual rates:

Semimonthly issues: United States and possessions, $75 postpaid; foreign countries, $90 postpaid

Cumulated index volumes: United States and possessions, $30 postpaid; foreign countries, $35 postpaid.

PUBLIC AVAILABILITY OF DOCUMENTS ANNOUNCED IN STAR

The source of documents announced in *STAR* varies, depending upon the organization which has originated and/or issued the document and the form (paper copy or microfiche[1]) in which the document can be provided. Documents produced by NASA, including its contractor and grantee documents, are identified by an asterisk (*) following the accession number (e.g., N71-10748*). Most of the NASA documents and many of the documents issued by other organizations have had microfiche copies produced. Those documents that can be obtained from some source on microfiche are indicated in *STAR* by the # symbol following the NASA accession number. All documents for which microfiche can be obtained are also available as facsimile or, for some, as printed copies.

Documents that can not be microfiched but for which one-to-one facsimile can be provided are indicated by a plus (+) instead of the # sign. Documents for which neither the + nor # symbol is shown, and for which no availability other than the issuing activity is given, may present unusual problems of reproducibility. The originator of such a document should be consulted as to its availability.

A source from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The NASA accession number is sufficient when ordering NASA and NASA-sponsored documents from NTIS. When ordering *non*-NASA documents (no asterisk) from the issuing agency or other sources, particularly NTIS, it is essential that additional bibliographic information such as the report number be given.

The following are the most commonly indicated sources (full addresses of these organizations are listed at the end of this Introduction):

Avail: NTIS. Sold by the National Technical Information Service at a standard price of $3.00 for hard copy (printed, facsimile, or reproduced from microcopy) of 550 pages or less. Documents in excess of 550 pages up to and including 1100 pages are sold for $10.00 per hard copy. Those in excess of 1100 pages are priced individually by NTIS. Microfiche is available from NTIS for 95 cents for those documents identified by the # sign following the accession number (e.g., N71-10936#). Standing orders for microfiche of (1) the full collection of documents announced in *STAR* with the # symbol following the accession numbers, (2) of NASA reports only (the "*" identifies), (3) of NASA-accessioned non-NASA reports only (see paragraph below), or (4) of any of these classes within one or more *STAR* categories also may be placed with NTIS at greatly reduced price per title over individual requests. Inquiries concerning the NTIS Selective Dissemination of Microfiche (SDM) should be addressed to the Subscription Unit, National Technical Information Service, Springfield, Virginia 22151.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The price is given following the availability line. (An order received by NTIS for one of these documents will be filled at the SOD price if hard copy is requested. NTIS will also fill microfiche requests, at the standard 95 cent price, for those documents identified by a # symbol. SOD does not sell microfiche.)

Avail: NASA Scientific and Technical Information Office. Documents with this availability are usually news releases or informational brochures available without charge in paper copy.

Avail: AEC Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of U.S. Atomic Energy Commission reports, usually in microfiche form, are listed in *Nuclear Science Abstracts*. Services available from the USAEC and its

(1) A microfiche is a transparent sheet of film, 105 × 148 mm in size, containing up to 72 pages of information reduced to micro images (not to exceed 20:1 reduction)

depositories are described in a booklet, *Science Information Available from the Atomic Energy Commission* (TID-4550), which may be obtained without charge from the USAEC Division of Technical Information.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts*, and are sold by University Microfilms, Inc. as xerographic copy (HC), microfilm, or microfiche at the prices shown. Microfiche are available only for those dissertations published since January 1, 1970. All requests should cite the author and the Order Number as they appear in the citation.

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by British Information Services (BIS), New York City. The U.S. price (including a service charge) is given, or a conversion table may be obtained from BIS.

Avail: National Lending Library, Boston Spa, England. Sold by this organization at the price shown. (If none is given, an inquiry should be addressed to NLL.)

Avail: ZLDI. Sold by the Zentralstelle für Luftfahrtdokumentation und -Information, Munich, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: U.S. Patent Office. Sold by Commissioner of Patents, U.S. Patent Office, at the standard price of 50 cents each, postage free. (See discussion of patents and patent applications below.)

Other availabilities: If the publication is available from a source other than the above, the publisher and his address will be displayed entirely on the availability line or in combination with the corporate author line.

EUROPEAN AVAILABILITY OF NASA AND AGARD DOCUMENTS

Facsimile copy or microfiche of NASA and NASA-sponsored documents identified by both the symbols "#" and "*" and those AGARD reports that are on microfiche may be purchased from:

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. de Neuilly
92-Neuilly-sur-Seine, France

AVAILABILITY OF DOCUMENTS TO REGISTERED NASA INFORMATION USERS

In addition to the common availability of all documents through the above sources, a limited number of information services are provided by NASA to those having a contractual or cooperative relation to NASA or whose scientific and engineering activities relate to space and aeronautics research. Organizations qualified to receive *STAR* without charge (see p. i) also may qualify for one or more of these services. Organizations that are not registered with NASA and wish to consider registering should request Form 713, Registration Form – Technical Publications, from the NASA Scientific and Technical Information Facility. Subject to the conditions of the approved registration forms, the following services may be made available:

Initial distribution of printed copies of NASA formal reports under specified subject categories. These selected reports, which contain the more significant NASA contributions to scientific or technical knowledge, may be recognized in *STAR* by their report numbers; they include NASA Technical Notes (NASA TN D's), Technical Reports (NASA TR R's), formally published and printed (low numbered) Contractor Reports (NASA CR's), Special Publications (NASA SP's), and selected (low numbered) Technical Translations (NASA TT F's).

Initial distribution of NASA-sponsored documents on microfiche is made to large users of NASA information for whom it would be advantageous to NASA to avoid processing numerous individual requests.

Secondary distribution of NASA reports on microfiche only (i.e., documents in *STAR* designated by both an asterisk (*) and a # symbol), may be obtained on request by registered recipients that do not receive microfiche on initial distribution. Organizations that are qualified to request reports should complete a Form 492, Document Request, for each microfiche request and transmit it to the NASA Scientific and Technical Information Facility.

Department of Defense documents (identified by the "AD" prefix) are generally available as *microfiche* on secondary distribution to *(DDC)* registered users at no cost from Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.

NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. They are identified by U.S. Patent No. and U.S. Patent Appl. Serial No. (SN) in the report/accession number index. The NASA Case number appears in lieu of the report number in the other indexes. In the abstract section of *STAR*, patents and patent applications (those for which no patents have yet been issued) are identified by respective subtitles in the citations.

Copies of NASA *patent application specifications* are sold by the National Technical Information Service at the established unit price of $3.00 for hard copy and 95 cents for microfiche. The NASA accession number should be used for ordering from NTIS.

Microfiche, but not paper copies, of the NASA patent application specifications also are available to registered requesters only at no charge from the NASA Scientific and Technical Information Facility. (Patents, in contrast to the patent applications, are not available as microfiche nor are paper copies of patents available from this source.)

Printed copies of the NASA *patents*, when identified by the U.S. patent number, may be purchased for 50 cents each, postage free, from:

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

It is necessary that payment be remitted in advance, preferably by money order or check payable to the Commissioner of Patents. Prepaid purchase coupons for ordering are also available from the Patent Office.

The patents and patent applications announced in *STAR* are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

Assistant General Counsel for Patent Matters/Code GP-1
National Aeronautics and Space Administration
Washington, D.C. 20546

COSATI SUBJECT CATEGORY CODE

In the citation of each NASA-supported document and of some non-NASA documents is a code, e.g., CSCL 25A, that indicates the subject category assigned to it from the COSATI Subject Category List (first ed. December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the National Technical Information Service or the U.S. Government Printing Office at $8.50 for the three-volume set.

SUBSCRIPTION TO NASA-ACCESSIONED NON-NASA MICROFICHE

Organizations that wish to maintain an integrated microfiche file of aerospace-related documents in order by the "N" accession number may obtain on automatic distribution "N" -numbered microfiche of *non*-NASA documents announced in *STAR*. The "N" number is the unique number under which the document is announced in *STAR* as well as indexed in and retrieved from the NASA information store. By special arrangement with NASA, the National Technical Information Service offers, on a subscription basis, the choice of (1) all non-NASA documents announced in *STAR* for which microfiche are available, distributed in "N" accession number sequence, or (2) all non-NASA documents in any one or more of the 34 *STAR* subject categories, distributed in "N" number sequence within each of the categories. The available documents are identified in *STAR by the "#"* symbol but do not show the "#" sign. The non-NASA documents are also available from NTIS in second generation microfiche, individually or by other sequence arrangements, under the originator's accession number ("AD," "PB," etc.). Inquiries for additional information and prices should be directed to: Subscription Unit, National Technical Information Service, Springfield, Virginia 22151.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
750 Third Ave.
New York, N.Y. 10017

British Information Service
845 Third Ave.
New York, N.Y. 10022

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. de Neuilly
92-Neuilly-sur-Seine, France

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

National Aeronautics and Space Administration
Scientific and Technical Information Office (KSI)
Washington, D.C. 20546

National Lending Library for Science and Technology
Boston Spa, Yorkshire, England

National Technical Information Service
Springfield, Virginia 22151

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms, Inc.
313 North First Street
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Atomic Energy Commission
Division of Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37830

Zentralstelle für Luftfahrtdokumentation und -Information
8 München 86
Postfach 880
Federal Republic of Germany

SUBSCRIPTION TO NASA ACCESSIONED NON-NASA MICROFICHE

Organizations that wish to maintain an integrated microfiche file of accepted related documents in order by the "N" accession number may obtain an automatic distribution "N" numbered microfiche of non-NASA documents announced in *STAR*. The "N" number is the unique number under which the document is announced in *STAR* as well as indexed in and retrieved from the NASA information store. By special arrangement with NASA, the National Technical Information Service offers, on a subscription basis, the choice of (1) all non-NASA documents announced in *STAR* for which microfiche are available, distributed in "N" accession number sequence, or (2) all non-NASA documents in any one or more of the 34 *STAR* subject categories, distributed in "N" number sequence within each of the categories. The available documents are identified in *STAR* by the "#" symbol but do not show the "#" sign. The non-NASA documents are also available from NTIS in second generation microfiche, individually or by other sequence arrangements, under the originator's accession number ("AD," "PB," etc.). Inquiries for additional information and prices should be directed to: Subscription Unit, National Technical Information Service, Springfield, Virginia 22151.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
750 Third Ave
New York, N.Y. 10017

British Information Service
845 Third Ave
New York, N.Y. 10022

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

ESRO/ELDO Space Documentation Service
European Space Research Organization
114 av. de Neuilly
92-Neuilly-sur-Seine, France

Her Majesty's Stationery Office
P.O. Box 569, S.E.1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

National Aeronautics and Space Administration
Scientific and Technical Information Office (KSI)
Washington, D.C. 20546

National Lending Library for Science and Technology
Boston Spa, Yorkshire, England

National Technical Information Service
Springfield, Virginia 22151

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms, Inc.
313 North First Street
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Atomic Energy Commission
Division of Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37830

Zentralstelle für Luftfahrtdokumentation und -Information
8 München 86
Postfach 880
Federal Republic of Germany

Volume 9 Number 3 / February 8, 1971

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page:

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **309**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **313**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **315**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **320**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **327**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **330**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **334**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **339**

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 348

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. 352

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 355

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 359

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 366

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 375

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. 384

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. 387

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. 388

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. 396

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. 398

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 402

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 404

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 413

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 417

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 419

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 436

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 439

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 445

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 448

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 450

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 451

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. 455

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. 459

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. 467

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. 469

SUBJECT INDEX I-1

PERSONAL AUTHOR INDEX I-55

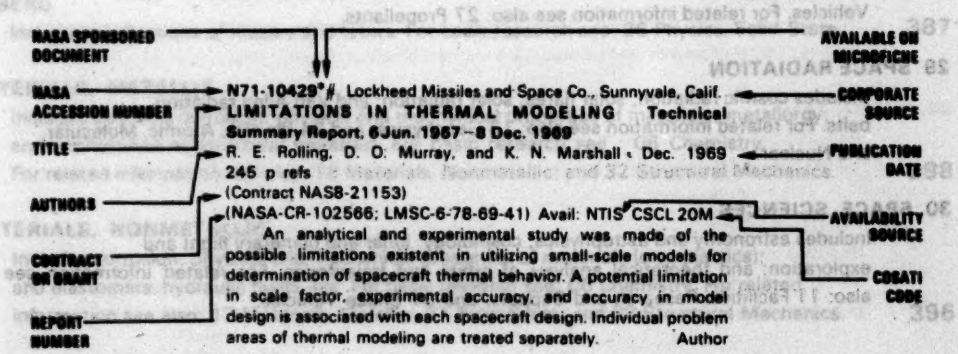
CORPORATE SOURCE INDEX I-79

CONTRACT NUMBER INDEX I-95

REPORT/ACCESSION NUMBER INDEX I-99

ACCESSION/REPORT NUMBER INDEX I-113

TYPICAL CITATION AND ABSTRACT FROM *STAR*


NASA SPONSORED DOCUMENT
AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N71-10429* # Lockheed Missiles and Space Co., Sunnyvale, Calif.
CORPORATE SOURCE
TITLE
LIMITATIONS IN THERMAL MODELING Technical Summary Report, 6 Jun. 1967 - 8 Dec. 1969
R. E. Rolling, D. O. Murray, and K. N. Marshall, Dec. 1969
PUBLICATION DATE
AUTHORS
245 p refs
(Contract NAS8-21153)
CONTRACT OR GRANT
(NASA-CR-102566; LMSC-6-78-69-41) Avail: NTIS CSCL 20M
AVAILABILITY SOURCE
An analytical and experimental study was made of the possible limitations existent in utilizing small-scale models for determination of spacecraft thermal behavior. A potential limitation in scale factor, experimental accuracy, and accuracy in model design is associated with each spacecraft design. Individual problem areas of thermal modeling are treated separately. Author
COSATI CODE
REPORT NUMBER

VOLUME 9 NUMBER 3 / FEBRUARY 8, 1971

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N71-12201 Kansas Univ., Lawrence.
WIND TUNNEL INVESTIGATIONS OF VORTEX BREAKDOWN ON SLENDER SHARP-EDGED WINGS
William Henry Wentz, Jr. (Ph.D. Thesis) 1969 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-21593

Systematic wind tunnel investigations of vortex breakdown on sharp-edged delta and modified delta wings with sweep angles from 45 deg to 85 deg at Reynolds numbers of about 1 million, utilizing a schlieren system for flow visualization are discussed. Vortex breakdown positions are presented as a function of angle of attack and sweep. Results agree well with the limited amount of previously published data. For the very slender wings (75 deg to 85 deg sweep), initial breakdown was nearly independent of sweep, a result not anticipated by extrapolation of previous data. Dissert. Abstr.

N71-12202# Stanford Univ., Calif. Thermosciences Div.
THE EFFECTS OF ROTATION ON BOUNDARY LAYERS IN TURBOMACHINE ROTORS
J. P. Johnston May 1970 64 p refs
(Grants NSF GK-2533; NSF GK-671)
(PB-192316; MD-24) Avail: NTIS CSCL 10A

The boundary layers in turbomachine rotors are subject to Coriolis forces which can (1) contribute directly to the development of secondary flows, and (2) indirectly influence the behavior of boundary layers by augmentation and/or suppression of turbulence production in the boundary layers on blades. Both these rotation-induced phenomena are particularly important in the development of understanding of flow and loss mechanisms in centrifugal and mixed flow machines. Author (USGRDR)

N71-12203# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.
AN EXPERIMENTAL INVESTIGATION OF ROTOR FORCES AND FLOW FIELD IN THE VICINITY OF A STEP GROUND PLANE
Ojars Skujins Jul. 1970 102 p refs
(Contract N00014-68-A-0512; Proj. Themis)
(AD-711955; TR-24) Avail: NTIS CSCL 1/1

The rotor force parameters considered were thrust, torque, pitching moment, and normal force, for the simulated flight conditions of hover, takeoff, and landing. The flow parameters investigated included tip vortex trajectories and streamline patterns. Additional studies were made to consider the effects of rotor blade mismatching upon thrust and power requirements of a rotor system. Author (TAB)

N71-12204# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
VISCOUS INTERACTIONS AND FLIGHT AT HIGH MACH NUMBERS Final Report
Robert H. Korkegi Jul. 1970 64 p refs
(AD-712075; ARL-70-0124) Avail: NTIS CSCL 20/4

Viscous interactions which arise in regions of high compression on high Mach number vehicles, can result in severely high local heating and flow degradation. Regions where such strong interactions may occur on a cruise vehicle are discussed. In relation to these regions, a brief review is given of advances in the understanding of two-dimensional shock wave-boundary layer interaction and separation in compression corners, and such three-dimensional interaction problems as a blunt fin on a surface, flow in an axial corner, and shock impingement. It is concluded that much progress has been made in analytical prediction of two-dimensional laminar interactions and a promising approach advanced for the turbulent case; knowledge of departures from two-dimensional flow and three-dimensional interactions is still largely empirical and dominantly qualitative, and even the inviscid flow field is not well know for many configurations of practical importance. Author (TAB)

N71-12205# Naval Ordnance Lab., White Oak, Md.
AN INVESTIGATION OF THE EFFECT OF FLEXIBLE TRAILING WIRE ON A HYPERVELOCITY CONE
Norman W. Sheetz, Jr. and Maigonis V. Krumins 11 Mar. 1970 61 p
(AD-712509; NOLTR-70-49) Avail: NTIS CSCL 20/4

A program to investigate the effect of a flexible trailing wire on the aerodynamic characteristics of a cone at very high Mach numbers is described. The experimental program was conducted in a 1000-foot hyperballistics range. The development of the technique for launching a conical configuration which has a small-diameter flexible wire attached to its base is described in detail. The effect of this appendage on the drag coefficient and the stability of the cone is presented. Also, the radar cross section of a cone with and without the trailing wire is compared. Author (TAB)

N71-12206# Naval Ship Research and Development Center, Washington, D.C.
AN INVESTIGATION OF THE EFFECT OF REYNOLDS NUMBER ON VELOCITY SURVEYS CONDUCTED IN THE

SUBSONIC WIND TUNNEL
Albert L. Boyle Sep. 1970 22 p ref
(AD-712527; NSRDC-3408) Avail: NTIS CSCL 20/4

Results are presented of an investigation of the effect of Reynolds number on velocity surveys conducted in a subsonic wind tunnel. A series of velocity surveys was conducted over a wide range of wind velocities. The surveys were made behind two configurations--an axisymmetrical body with appendages and a three-cycle wake screen. The shape of the velocity distribution curves was related to changes in wind velocity; the mean values of the distributions were also related to velocity. Author (TAB)

N71-12207# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
THE STABILITY OF SMOOTH TWO-DIMENSIONAL TRANSONIC FLOWS Final Report
Morris P. Isom and Kwang Shu Wu Jun. 1970 29 p refs
(Grant AF-AFOSR-1578-68)
(AD-712702; NYU-AA-70-14; AFOSR-70-1787TR) Avail: NTIS CSCL 20/4

The stability of smooth (shock-free) two-dimensional transonic flows to acoustic disturbances is discussed. The problem is considered in the context of transonic flow over airfoil sections, with weak waves moving upstream into the region of embedded supersonic flow. In particular, Spees work on stability criteria for such flows is reviewed, and the problem is reformulated within the framework of geometrical acoustics. It is shown that the assumptions appropriate for a linearized theory appear to fail when acoustic waves become tangent to characteristics of the undisturbed flow field. The assumptions of linear theory are implicit in Spees work. The results presented here indicate that stability theory must be based on a more careful and detailed analysis of wave propagation through the supersonic region. Author (TAB)

N71-12208*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERALL PERFORMANCE OF 6-INCH RADIAL-BLADED CENTRIFUGAL COMPRESSOR WITH VARIOUS DIFFUSER VANE SETTING ANGLES
Calvin L. Ball, Carl Weigel, Jr., and Edward R. Tysl Washington Nov. 1970 20 p refs
(NASA-TM-X-2107; E-5681) Avail: NTIS CSCL 20D

Overall compressor performance is presented as a function of equivalent weight flow for five different diffuser vane setting angles. For design speed, the weight flow corresponding to the peak efficiency was varied from 100 percent of design flow to 65 percent by operating the compressor with the five different diffuser vane angles. Over the range of diffuser vane setting angles tested, the peak efficiency of the compressor remained essentially constant at 78 percent. Author

N71-12209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERALL PERFORMANCE IN ARGON OF 4.25-INCH SWEPTBACK-BLADED CENTRIFUGAL COMPRESSOR
Carl Weigel, Jr., Edward R. Tysl, and Calvin L. Ball Washington Nov. 1970 19 p refs
(NASA-TM-X-2129; E-5582) Avail: NTIS CSCL 20D

Overall compressor performance is presented as a function of equivalent weight flow. At the design equivalent weight flow of 0.581 lb/sec (0.263 kg/sec) and the design equivalent tip speed of 949 ft/sec (289 m/sec), the compressor produced an overall total-pressure ratio of 1.92 and an adiabatic efficiency of 0.795. The peak efficiency at design speed was 0.819 and occurred at an equivalent weight flow of 0.508 lb/sec (0.230 kg/sec). Author

N71-12210*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Aero-Thermodynamics.
ANALYSIS OF THE EXPERIMENTALLY DETERMINED AERODYNAMIC NOISE ENVIRONMENT FOR THREE NOSE-CYLINDER CONFIGURATIONS
J. Peter Reding and Rolf A. Guenther Oct. 1969 53 p refs
(Contracts NAS8-21459; F04701-68-C-0061)
(NASA-CR-102933; N-3C-69-2) Avail: NTIS CSCL 20D

Aerodynamic noise measurements were obtained on three nose-cylinder configurations, a 15 deg cone-cylinder, a biconic nose-cylinder, and a biconic nose-corrugated cylinder. The measurements were intended to assess the effects of the biconic nose and corrugated skin on the aerodynamic noise environment. However, an analysis of the data revealed that the model skin may have been vibrating. The resultant accelerations experienced by the microphones and perturbations of the flow preclude valid noise measurements except directly under the terminal normal shock where the very high aerodynamic noise dominates the microphone response. The biconic nose with smooth afterbody produced lesser shock-induced sound pressure levels (SPL's) than the aerodynamically cleaner single cone-cylinder configuration. This was due primarily to the reduced flow turning at the nose-cylinder shoulder aft of the preseparation and reattachment at the upstream cusp. The biconic corrugated configuration produced the most severe noise environment due to local effects at the corrugation leading edges, including the vorticity shed along the corrugation edges. Author

N71-12211*# North American Rockwell Corp., Los Angeles, Calif.
DYNAMIC DISTORTION AT THE EXIT OF A SUBSONIC DIFFUSER OF A MIXED COMPRESSION INLET
Arnold W. Martin, Leonard C. Kostin, and Sidney D. Millstone Washington NASA Dec. 1970 349 p refs
(Contract NAS2-4667)
(NASA-CR-1644) Avail: NTIS CSCL 20D

Dynamic distortion characteristics at the engine face station of a 20 in. diameter axisymmetric inlet were investigated at M = 2.6 and 3.0. Inlet operation modes included: (1) stationary geometry and tunnel conditions, (2) sinusoidal exit area disturbances, (3) simulated engine transients, (4) sinusoidal external flow disturbances, and (5) simulated clear air turbulence. Inlet-induced turbulence is composed of random and nonrandom pressure oscillations. The basic turbulence generating mechanism appears to be boundary layer/shock interaction. Regions of maximum turbulence correspond with regions of maximum pressure recovery. Instantaneous (msec) spatial distortions appreciably exceed steady state distortions during highly supercritical inlet operation. Author

N71-12212 Northwestern Univ., Evanston, Ill.
EXPERIMENTAL INVESTIGATION OF MAGNETOAERODYNAMIC FLOW AROUND BLUNT BODIES
Stanley Charles Kranc (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-94

The drag forces on a body with a self-contained electro-magnet are measured when the body is placed in a low density argon plasma stream. Tests are conducted in a steady flow of plasma produced in a direct current arc and expanded to supersonic speeds. Measurements are restricted to one flow condition where the influence of viscosity and the Hall effect are both important. The flow field around the body is investigated spectroscopically, and the predicted increase in shock stand-off distance is observed photographically. An unexpected visible color change which occurs when the magnetic field is applied is also investigated. Spectroscopic measurements show that the electrons in the plasma are out of thermal equilibrium in the plasma and the flow is essentially non reacting. The influence of these facts on other experimental measurements is considered. Dissert. Abstr.

N71-12213*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL ANALYSIS AND MEASUREMENT OF SINGLE-PHASE PRESSURE LOSSES AND HEAT TRANSFER

FOR HELICAL FLOW IN A TUBE

Martin U. Gutstein, George L. Converse (GE., Cincinnati), and Jerry R. Peterson (GE., Cincinnati) Washington Nov. 1970 58 p refs

(NASA-TN-D-609; E-5743) Avail: NTIS CSCL 20D

An analysis of flow inside a tube containing a helical-vane insert was conducted based on solid-body rotation. Equations were derived for the momentum and frictional pressure losses for fully developed flow in these inserts. Modified plain-tube expressions for friction factor and Stanton-Prandtl modulus, obtained from the analysis, were used to predict the performance of tubes with helical-vane inserts. Experimentally determined friction factors and Stanton-Prandtl moduli, obtained with four different inserts over a Reynolds number range of 30,000 to 300,000, were found to deviate from the predictions by about + or − 20 and + or − 15 percent, respectively, suggesting the analysis to be largely correct. A similar approach for other swirl-generating inserts yielded reasonable agreement of experimental data with predictions. Author

N71-12214# Royal Aircraft Establishment, Farnborough (England).

FLIGHT ASSESSMENT OF A DOUGLAS TRAILING-CONE STATIC-PRESSURE PROBE AT SUBSONIC SPEEDS

C. S. Barnes Jul. 1969 26 p refs

(RAD-TR-69139) Avail: NTIS

Pressure error evaluation tests were made, using the tower fly-by technique at speeds up to 350 kt (M_∞ = 0.53), with promising results. The cone, which was trailed from the fuselage tail cone of a Meteor aircraft, had a pressure error at sea level equivalent to less than + or − 10 feet error in altitude for trail lengths greater than 50 feet and for most aircraft configurations. This error was significantly increased by aircraft flap deflection which caused cone unsteadiness, probably due to rotation of the cone within the flap vortex. It is believed that this behavior would not occur if the cone were trailed from the fin tip of the test aircraft. The results suggest that there might be slight interference from the jet wakes of the wing mounted engines of the Meteor, but this could not be confirmed. Author

N71-12215*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL STUDY OF THE SHOCK WAVE DUE TO A BLUNT LEADING EDGE IN THE HYPERSONIC MERGED-FLOW REGIME

Roger M. Winebarger Washington Dec. 1970 19 p refs

(NASA-TN-D-6017; L-7019) Avail: NTIS CSCL 01A

An experimental investigation of low-density flow over two-dimensional blunt bodies was conducted in the Langley 1-foot (0.305-meter) hypersonic arc tunnel. Pitot-pressure surveys were obtained over a range of tunnel test conditions with Mach number varying from 11.8 to 13.7, total enthalpy varying from 2.41 MJ/kg to 3.98 MJ/kg, and free-stream Reynolds number varying from 45,900 to 103,000 per meter. The models were cylinders having diameters between 0.05 mm and 11.1 mm and a 1.6-mm-thick flat plate with a leading-edge radius of 0.8 mm. Transverse impact pressure surveys were made from 2 to 55 diameters downstream of the leading edge. All data were obtained in the merged-flow regime and the test data show that even at the highest Reynolds numbers, significant departures from Rankine-Hugoniot shock relations are present. The data indicate, in terms of Mach number and Reynolds number, the leading-edge radius at which a body may be considered sharp; that is the test conditions are defined where the leading edge was sufficiently small so that a measurable shock was not produced. This condition occurred when the cylinder radius was approximately equal to one mean-free-path length. Author

N71-12216 Cincinnati Univ., Ohio.

EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE NEAR WAKE BEHIND A REARWARD FACING STEP IN SUPERSONIC FLOW

Howard Edwin Smith (Ph.D. Thesis) 1969 130 p

Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-4275

The experimentally measured heat transfer distribution along the reattachment surface downstream of the step is also presented. An extension experimental program was conducted using a water-cooled model in a 40 inch × 40 inch continuous-run wind tunnel facility, thus permitting steady state conditions to be obtained for each model configuration and flow condition. The test model was 9 inches wide and was constructed so that the step height could be adjusted to 0.0 (flat plate condition), 0.443 and 0.750 inches. The model was instrumented with surface pressure orifices and steady state heat transfer gauges. Specially designed probes were used to measure the properties of the flow. Tests were conducted at free stream Mach numbers of 2.5, 3.5 and 5.0 over a range of Reynolds numbers based on length of surface upstream of separation from approximately 250,000 to 1,800,000. Several representative flow fields are presented, along with analyses of the various regions of these fields. Dissert. Abstr.

N71-12217*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

LIFTING BODY Patent Application

William T. Holmes, inventor (to NASA) Filed 4 Feb. 1970 3 p

(NASA-Case-FRC-10063; US-Patent-Appl-SN-21283) Avail: NTIS CSCL 01C

Design drawings depict a delta shaped lifting body with thickened, almost conical center and flat triangular side wings. Shown are top and bottom plans, side and elevational views, and also a perspective view of the new design. NASA

N71-12218*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ACOUSTIC PROPERTIES OF A SUPERSONIC FAN

A. W. Goldstein, F. W. Glaser, and J. W. Coats [1970] 17 p refs Presented at the 9th Aerospace Sci. Meeting, New York, 25–27 Jan. 1971; sponsored by AIAA

(NASA-TM-X-52937) Avail: NTIS CSCL 20D

The acoustic properties of a supersonic fan of short blade length are discussed. Measurements were obtained with and without stator blades to provide control of wake-chopping and other blade row interference effects. Both internal and external measurements show a relation between the internal shock wave configuration and the intensity of the radiated sound. Substantial variations in the flow conditions at each blade of a homogeneous blade row provide an obvious source of the observed pure tone system based on multiples of the rotational speed of the shaft. Author

N71-12219*# Scientific Translation Service, Santa Barbara, Calif.

COMPUTATION OF THE PRESSURE FIELD INDUCED BY THE OSCILLATION OF A CONTROL SURFACE IN SUBSONIC FLOW [CALCU DU CHAMP DE PRESSION INDUIT PAR L'OSCILLATION D'UNE GOUVERNE EN ECOULEMENT SUBSONIQUE]

R. Dat et al Washington NASA Nov. 1970 17 p refs Transl. into ENGLISH from Rech. Aerospatiale (Paris), no. 2, Mar.–Apr. 1970 p 121–126

(Contract NASw-2035)

(NASA-TT-F-13385) Avail: NTIS CSCL 01A

The computation of pressure induced by control surface oscillation is discussed. The method is based on the analysis of the matrix solution to the lifting surface problem and on the expression of pressure distribution in the vicinity of lines of singularity. Application to the rectangular airfoil has given satisfactory results in the sense that convergence is good as a function of the number of components retained in the pressure expansion. Author

N71-12220# Institut Franco-Allemand de Recherches, St. Louis (France).

USE OF THE SCHLIEREN PROCESS AS MEASURING

METHOD (FOUCALT'S SCHLIEREN SYSTEM, METHOD OF AMPLITUDE SUBTRACTION, SCHLIEREN FRINGES WITH PHASE SHIFTING) [LA STRIOSCOPIE. SON UTILISATION COMME METHODE DE MESURE. (EXPERIENCE DE FOUCAULT. METHODE DE SOUSTRACTION D'AMPLITUDES. COUTEAUX DEPHASANTS.)]

L. Oudin and A. Kalt 16 Oct. 1969 34 p refs In FRENCH
(ISL-T-42/69) Avail: NTIS

Described is a schlieren method that uses monochromatic light from a point source to observe one-dimensional objects through a limited pupillary system. Images of phase objects consisting of transparent right angle pikes or of transparent slanted pikes are obtained by applying a Foucault schlieren method (shuttering of lense half-plane by schlieren fringe), amplitude subtraction (corresponding to the Hilbert transformation), and a phase plate that results in a pi/2 phase shift in lense half-plane. Intensities as functions of horizontal coordinates as well as the complex amplitudes (of the picture) are outlined. Numerical reconstruction of phase objects is attempted by: (1) using two intensity distributions of two photos to develop a Fredholm integral equation as a solution for objective phase reconstruction; or (2) by using convolution products if the objective phase is weak and the complex picture amplitude is either uniformly regular or corresponds to a simple law. Transl. by G.G.

N71-12221# Institut Franco-Allemand de Recherches, St. Louis (France).

APPLICATION OF THE SCHLIEREN PROCESS TO THE DENSITY MEASUREMENT ON HYPERSONIC WAKES IN THE FREE FLIGHT TUNNEL [METHODES STRIOSCOPIQUES DE MESURE DES MASSES VOLUMIQUES DANS LES SILLAGES HYPERSONIQUES EN TUNNEL DE TIR]

P. Smigielski, L. Oudin, A. Kalt, F. Albe, M. Devaud et al 5 Mar. 1969 29 p refs In FRENCH
(ISL-T-12/69) Avail: NTIS

Geometrical and physical parameter effects of an optical schlieren system with double fringes and double penetration on phase observations in the wake of a hypervelocity projectile traveling through the atmosphere at low pressure, are studied. Optimization of instruments for measuring light diffraction considers photographic emulsion sensitivity. Obtained light diffraction values are used to calcu ate the distribution of diffractive indices by a linearization method if the step-wise continuing distribution has a symmetrical rotation axis; an example calculation is included (entropy wake). The application of holography in free flight tunnels is outlined. Author

N71-12222# Institut Franco-Allemand de Recherches, St. Louis (France).

GRAPHS FOR THE DETERMINATION OF TRAJECTORY CHARACTERISTICS AND PERTURBATION COEFFICIENTS [DIAGRAMME ZUR BESTIMMUNG VON SCHUSSBAHNDATEN UND STOERUNGSKOEFFIZIENTEN]

H. Molitz and Saint-Martin 11 Jul. 1969 41 p In GERMAN
(ISL-T-27/69) Avail: NTIS

Presented diagrams contain the results of systematical trajectory calculations for common projectiles. A normal atmospheric resistance law is used to evaluate various ballistic coefficients, velocity increases and initial velocities, the firing distances, the flight times, and final ballistic velocities at level point as well as the disturbance values. Graphs provide a quick determination of ballistic data (optimal firing distance, etc.). Author

N71-12223# Institut Franco-Allemand de Recherches, St. Louis (France).

OPTICAL METHODS APPLIED IN THE FREE FLIGHT TUNNEL [LES METHODES OPTIQUES APPLIQUEES AU TUNNEL DE TIR]

P. Smigielski, H. Royer, and F. Albe 1 Oct. 1969 30 p refs In FRENCH
(ISL-T-39/69) Avail: NTIS

Classical holographic methods are briefly described and the experimental evaluation of the following optical holographic methods are outlined: (1) hologram analysis by laser schlieren photography with phase plate defocusing (this gives a phase shift of 180 deg in a half-plane); and (2) flow visualization of hypervelocity sphere wakes by differential interferometry with polarized light and laser schlieren method with amplitude substraction. Author

N71-12224*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

THE USE OF AUTOMATIC CONTROL THEORY AND A PILOT MATH MODEL IN HELICOPTER MANUAL CONTROL SYSTEM SYNTHESIS

Paul S. Rampfer, Lloyd Stevenson, and Dennis Collins Oct. 1968 18 p
(NASA-TM-X-66492; PM-64) Avail: NTIS CSCL 01A

An investigation into the use of automatic control theory with a simple pilot model for synthesizing helicopter landing approach flight director control laws was made. The synthesis technique was successful and was subsequently used to define flight director control laws for the Langley Research Center CH-46C tandem rotor helicopter. Author

N71-12225*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

TWO SETS OF LINEARIZED AIRCRAFT EQUATIONS OF MOTION FOR CONTROL SYSTEM ANALYSIS

Paul S. Rempfer and Lloyd Stevenson Aug. 1968 20 p refs
(NASA-TM-X-66493; PM-56) Avail: NTIS CSCL 01A

In developing a mathematical model for a tandem rotor helicopter to use in the analysis of an automatic approach and landing system, linearized equations not normally used in aircraft along with those normally used. Author

N71-12226# Carleton Univ., Ottawa (Ontario). Div. of Aerothermodynamics.

A COMPUTER PROGRAM FOR THE ANALYSIS AND DESIGN OF THE FLOW IN TURBOMACHINERY. PART B: LOSS AND DEVIATION CORRELATIONS

W. R. Davis Jul. 1970 113 p refs
(ME/A-70-1) Avail: NTIS

A computer program is described which calculates design (or minimum loss) and off-design total pressure loss coefficient and deviation angle for a given blade geometry and inlet air angle. A number of options are provided for the user regarding the method used to make the calculations, and the particulars of the various options are included. A test case with sample input and output and the FORTRAN listings are provided. Author

N71-12227*# General Motors Corp., Indianapolis, Ind.

EXPERIMENTAL INVESTIGATION IN AN ANNULAR CASCADE SECTOR OF HIGHLY LOADED TURBINE STATOR BLADING. 5: PERFORMANCE OF TWO TANGENTIAL JET BLADES

James L. Bettner Washington NASA Nov. 1970 167 p refs
(Contract NAS3-9404)
(NASA-CR-1675; EDR-5315) Avail: NTIS CSCL 21E

Two low reaction tangential jet turbine stator blade configurations were tested in a six-blade annular cascade. A plain blade, designed to the same aerodynamic requirements, was tested for performance comparison. The two tangential jet configurations differed by and were identified by the axial position of the jet slot. The slot was located at approximately 38 percent of the axial chord for the number 1 blade and at about 57 percent for the number 2 blade. The tangential jet blade surface contours were identical to the plain blade, except in the aft suction surface region which was modified to accommodate the jet slots. Three jet slot sizes of 0.020, 0.030, and 0.040 inch with three secondary flow rates for each slot were investigated for both number 1 and 2

blades. Secondary flow rates of up to nearly 7.5 percent of the primary flow were investigated. All configurations were tested at the design values of inlet gas angle and Mach number. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N71-12230# School of Aerospace Medicine, Brooks AFB, Tex.
NOISE ASSOCIATED WITH OPERATION OF AIR FORCE OV-10A AIRCRAFT Final Report, Apr. – May 1970
Donald C. Gasaway Aug. 1970 20 p refs
(AD-712667; SAM-TR-70-51) Avail: NTIS CSCL 20/1

Noise measurements are described for near-field positions during engine-starting and pre-takeoff phases of the OV-10A aircraft. The internal noise environment during various phases of ground and airborne operations is described and illustrated. Features of aeromedical importance are emphasized. Author (TAB)

N71-12231# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
LANDING GEAR SYSTEM ANALYSIS
David Bruce Tremblay Mar. 1970 87 p
(AD-712661; ASD-TR-69-113) Avail: NTIS

This report utilizes a matrix format to conduct an analysis of the basic functions of the landing gear system. The interplays of components are identified and the contribution which each component makes in the completion of the function is defined. The analysis is further expanded into a detailed component analysis identifying the modes of failure and physical characteristics brought into play in the completion of each function. These observations are then collated and trends are noted. Potential improvements and needs are defind for future development methods. Author (TAB)

N71-12232# Georgia Univ., Athens. Dept. of Zoology.
RADAR TECHNIQUES FOR AIR FORCE APPLICATIONS IN AVOIDANCE OF BIRD-AIRCRAFT COLLISIONS AND IMPROVEMENT OF FLIGHT SAFETY Final Report
S. A. Gauthreaux, Jr. 1 Aug. 1970 7 p refs
(Grant AF-AFOSR-1879-70)
(AD-712720; AFOSR-70-2487TR) Avail: NTIS CSCL 6/3

The report describes the results of a study using United States Weather Bureau WSR-57 radar on the density and timing of migratory flights of birds in and through the southern United States, the orientation of migratory flights and the effects of various weather factors on the orientation process, and the role of bird migration in weather forecasting. The area of investigation provided needed data on migratory movement of birds in an effort to reduce the potential hazards posed to military aircraft by these migrations. The simultaneous weather data gathered during the study were correlated with the migratory movements in an attempt to understand the influence of meterological factors on bird migration. These data are being analyzed for publication. Author (TAB)

N71-12233# National Aeronautical Establishment, Ottawa (Ontario).
A NOTE ON THE LOADS IMPOSED ON FIXED-WING LIGHT AIRCRAFT DURING AGRICULTURAL OPERATIONS
Richard Sewell 31 Aug. 1970 30 p refs
(LTR-ST-422) Avail: NTIS

The available published information on the flight and ground loads to which fixed-wing light aircraft are subjected during agricultural operations is summarized. Mathematical formulas are developed which may be used to obtain estimates of the total fatigue damage resulting from any combinations of mean stress, stress increment per g, number of flight hours, and frequency of ground-air-ground cycles per flight hour. It is shown that the fatigue damage resulting from the loads imposed during taxying on rough surfaces may be two orders of magnitude greater than that resulting from the average-case flight loads experience. Author

N71-12234*# Scientific Translation Service, Santa Barbara, Calif.
ATMOSPHERIC REFRACTION AND REFLECTION IN SONIC BOOMS [REFRACTION ATMOSPHERIQUE ET REFLEXION AU SOLDES BANGS]
C. Thery Washington NASA Dec. 1970 22 p refs Transl. into ENGLISH of AGARD Proceedings on Aircraft Engine Noise and Sonic Boom, no. 42, May 1969
(Contract NASw-2035)
(NASA-TT-F-13409) Avail: NTIS CSCL 20A

A new analytical method is applied to the atmospheric refraction of weak intensity repeater shock waves. The results are in excellent agreement with the flight analysis of Jericho. Experimental shock tube studies reported here are considered less conclusive. Author

N71-12235*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A COMPARISON OF AIRCRAFT AND GROUND VEHICLE STOPPING PERFORMANCE ON DRY, WET, FLOODED, SLUSH-, SNOW-, AND ICE-COVERED RUNWAYS Final Report
Thomas J. Yager, W. Pelham Phillips, Walter B. Horne, and Howard C. Sparks (Aeron. Systems Div.) Washington Nov. 1970 197 p refs Sponsored in part by USAF
(NASA-TN-D-6098; L-7565) Avail: NTIS CSCL 01B

A joint USAF-NASA research program has studied the stopping performance of an instrumented C-141A four-engine jet transport and several instrumented ground vehicles on 50 runways in the United States and Europe under dry, wet, flooded, slush, snow, and ice conditions. It is shown that measurement of the stopping distance of a diagonal-braked ground vehicle provides a meaningful measure of the slipperiness of a wet runway, and permits accurate prediction of the stopping distance of an aircraft under varied runway slipperiness conditions as well as a means for realistic calculation of crosswind limitations. It is also shown that aircraft stopping performance on a wet runway can be considerably improved either by grooving the runway or by use of a porous surface course. Author

N71-12236# Boeing Co., Philadelphia, Pa. Vertol Div.
EVALUATION OF GEARED FLAP CONTROL SYSTEM FOR TILTWING V/STOL AIRCRAFT
G. B. Churchill 11 Aug. 1970 109 p refs
(AD-712645; D8-2076) Avail: NTIS CSCL 1/3

The geared flap control system provides a means for controlling a tiltwing V/STOL aircraft in hover and transition flight without the use of auxiliary systems such as cyclic propeller pitch or tail jets/rotors. The system is based on using the flap as an aerodynamic servo to position the wing relative to the fuselage. Although the system is mechanically simple, the control characteristics are difficult to visualize because of the coupled body dynamics involved. Therefore, a comprehensive analytical and model testing program was performed to evaluate the system. Author (TAB)

N71-12237 Northwestern Univ., Evanston, Ill.
A FEASIBILITY STUDY OF V/STOL AIR TRANSPORTATION IN THE APPALACHIAN REGION: A CONCEPTUAL FRAMEWORK AND EXAMPLE ANALYSIS

Everett Charlie Carter (Ph.D. Thesis) 1969 293 p
Avail: Univ. Microfilms: HC $13.30/Microfilm $3.80 Order No. 70-23

The feasibility of a major transportation innovation in a region was studied. The attempt was to study the factors involved in an air transportation system and to develop an approach to the systems study of a regional air transportation system; and to use the methodology developed to study the feasibility of introducing vertical or short take off and landing (V/STOL) air transport in the Appalachian region. By developing a decision diagram for transportation in the Appalachian Region, it was determined that the objective of this research in studying the feasibility of V/STOL was within the regional goals of improving the economy of the region. In order to keep the study manageable, West Virginia was chosen as representative of the region. A study of existing and projected technology led to the selection of short take-off and landing (STOL) vehicles for detailed study. Two types of systems were formulated as realistic for West Virginia; they both included a jet airport at Charleston and feeder airports at other cities. The first type of system would have the feeder airports served by STOL aircraft and the second type would use conventional take-off and landing (CTOL) aircraft to serve the feeder airports. Dissert. Abstr.

N71-12238# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
AIRCRAFT WESERFLUG Bf 163 D-IUCY [VERBINDUNGSFLUGZEUG WESERFLUG Bf 163 D-IUCY]
Hans Justus Meier 1970 53 p refs In GERMAN *Its* Flugzeug-Monografie Nr. 3
Avail: NTIS

The history of the Weserflug Bf 163 aircraft is described. Details are given on the reconstruction of a model of this light liaison aircraft. ESRO

N71-12239*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF A FOUR-ENGINE EXTERNALLY BLOWING JET-FLAP STOL AIRPLANE MODEL
Raymond D. Vogler Washington Dec. 1970 86 p refs
(NASA-TN-D-7034; L-7546) Avail: NTIS CSCL 01A

The low speed longitudinal aerodynamic characteristics of a model of a four engine externally blowing jet-flap STOL aircraft are discussed. Data were obtained at low speeds over a moving ground plane through a model angle of attack range, various model heights, flap deflections, and momentum coefficients for high wing and low wing configurations. Results over the moving and the fixed ground plane show few differences for the high wing configuration except for small increments of forces and moments at the higher blowing momentum coefficients. Author

N71-12240# Boeing Scientific Research Labs., Seattle, Wash.
JET NOISE SUPPRESSION BY AN IMPEDANCE SHROUD
Ian S. F. Jones Jun. 1970 26 p refs
(AD-712406; DI-82-0984) Avail: NTIS CSCL 20/1

Jet noise can be attenuated by shielding the observer from the noise sources with a sheet of fluid having a different acoustic impedance to the undisturbed atmosphere. The attenuation due to a heated sheet of gas lying on an arc centered on the axis of a subsonic jet was measured. The maximum noise reduction in certain frequency bands in this experiment was 10 dB. Author (TAB)

N71-12241# Federal Aviation Administration, Washington, D.C. Flight Standards Service.
PILOTS WEIGHT AND BALANCE HANDBOOK
1969 74 p
(FAA-AC-91-23) Avail: SOD $0.70; NTIS

The importance of weight and balance control as it relates to aircraft safety is discussed. An instruction manual for computing and solving weight and balance problems for various types of aircraft is presented. Pertinent FAA regulations, publications, and advisory circulars which have an impact upon weight and balance procedures are considered in the development of the text. Author

N71-12242# Oak Ridge National Lab., Tenn.
DESIGN AND DEVELOPMENT OF A STABILIZED BALLOON GONDOLA FOR AN ASTRONOMICAL GAMMA RAY SPECTROMETER
T. J. Golson Aug. 1970 47 p
(Contract W-7405-ENG-26)
(ORNL-TM-2882) Avail: NTIS

A stabilized balloon gondola was designed to lift a 1500-lb gamma ray spectrometer to an altitude of 100,000 ft and orient it to measure gamma rays from outer space. An overhead bearing assembly was designed to uncouple the gondola from the rotation of the balloon, and a gas jet reaction system was used to orient the gondola with respect to the target to be tracked. Preflight tests were conducted on individual components of the gondola and on the gondola as a unit. The tracking accuracy and functional capability of the unit were tested in actual flight and it was determined that the gondola can be successfully launched and recovered with a minimum of damage. Author

N71-12243* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AIRCRAFT Patent
Augustine W. Robins, Roy V. Harris, Jr., Harry W. Carlson, Francis E. McLean, and Wilbur D. Middleton, inventors (to NASA) Issued 21 Mar. 1967 (Filed 21 May 1965) 7 p Cl. 244-45
(NASA-Case-XLA-04451; US-Patent-3,310,262; US-Patent-Appl-SN-457876) Avail: US Patent Office CSCL 01C

The design is described of a supersonic aircraft having fixed substantially arrow-wing planform configurations and considered to be particularly useful for application to civilian and military transport or military surveillance and bombardment aircraft. The stated benefits of the proposed aircraft design include: (1) provides a new and improved fixed, swept-wing planform; (2) utilizes wing areas of receding slope to provide maximum utilization of the inherent nacelle-wing airflow interference; (3) provides an improved planform in which a twisted and cambered wing is utilized for maximizing supersonic flight efficiency; and (4) provides a novel aircraft configuration in which the wing fuselage-nacelle combination is self-trimming and the drag-due-to-lift is considerably lower than that of a low-sweep flat wing configuration of conventional aircraft. D.L.G.

N71-12244*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
ERC V/STOL PROGRAM FLIGHT TEST PLAN. H-19 FLIGHT PROGRAM PHASES 1A AND 1B, WALLOPS STATION, VIRGINIA
May 1968 77 p
(NASA-TM-X-66494; PM-51) Avail: NTIS CSCL 01A

The general flight test plan for the first two phases of the H-19 flight test program is presented. The test program is described and guidelines are established for the detailed plans which will be documented in the procedures and operations manuals. The major flight test objective is to obtain experimental data on an aided inertial system for terminal guidance and navigation of a helicopter for use in designing a V/STOL avionics system. This plan defines: detailed objectives, success criteria, testing approach, system and instrumentation descriptions, flight profiles, test descriptions, facilities, data recovery, post-flight analysis, and schedules. Author

N71-12245*# Translation Consultants, Ltd., Arlington, Va.
THE INFLUENCE OF POROSITY ON THE PERFORMANCE AND PROPERTIES OF PARACHUTES [DER EINFLUSS DER POROSITAET AUF LEISTUNG UND EIGENSCHAFTEN VON FALLSCHIRMEN]

H.-D. Melzig Washington NASA Sept. 1969 21 p refs Transl. into ENGLISH from German Aero- and Astron., Lectures at the DFVLR Inst. of Aerodynamics at the DGLR-DFVLR-AGARD Symp. on Parachutes and Rescue Systems (Braunschweig), 15–19 Sep. 1969
(Contract NASw-2038)
(NASA-TT-F-13431) Avail: NTIS CSCL 11E

The definitions for air permeability and porosity are explained. Results of air permeability measurements for a variety of cloth at differential pressures from 0 to 500 mm H2O are reported. An empirical formula for the calculation of air permeability at any differential pressure in this range is given. The influence of porosity of the parachute canopy on canopy shape and filling on opening forces, filling time, and stability is reported. The influence of air density on porosity is discussed. Author

N71-12246# Institut Franco-Allemand de Recherches, St. Louis (France).
INTERACTION BETWEEN AIRCRAFT BOOM AND OBSTACLES. PART 2: STUDY OF THE REFLECTION OF AN AIRCRAFT BOOM IN A VALLEY BASIN [INTERACTION ENTRE BANGS ET OBSTACLES. 2EME PARTIE: ETUDE DE LA REFLEXION D'UN BANG DANS UN FOND DE VALLEE]
C. Thery, A. Peter, and M. Pfister 10 Mar. 1970 64 p refs In FRENCH
(ISL-T-9/70) Avail: NTIS

N-wave reflection from the walls of a deep valley basin is analyzed by representing the reflecting plane schematically as the segment of a circular cylinder. Studied is the reflection from an infinite semicircular cylindrical plane (two-dimensional analysis) by applying shadow photography and interferograms to determine wave structure in the vicinity of the caustic surface as well as the geometrically limited development of high overpressure in the vicinity of the triple point in the developed Y. Evaluation of the pressure field provides the U-shape of the reflected pressure signature and the important amplitudes of the pressure points in the vicinity of the focus. A three-dimensional reflection study in a valley basin having walls of infinite heights provides that at a small (or high) incidence angle wave reflection corresponds to results from two-dimensional calculations. At incidence angle of about 30 deg, focusing is only obtained when the valley basin is so deep that three-dimensional effects develop immediately after passage of reflecting wave fronts with only brief pressure peak developments. It is assumed that limiting shock front development times and irregular shape of natural topography level pressure peaks of aircraft booms. Transl. by G.G.

N71-12247# Institut Franco-Allemand de Recherches, St. Louis (France).
INTERACTION BETWEEN AIRCRAFT BOOMS AND OBSTACLES. PART 1: RESEARCH TECHNIQUES AND THEIR APPLICATION TO THE INVESTIGATION OF THE ENEVELOPE OF A STRUCTURE [INTERACTIONS ENTRE BANGS ET OBSTACLES. 1ERE PARTIE: TECHNIQUES D'ETUDE ET APPLICATION A L'ETUDE DE L'ENVELOPPEMENT D'UNE CONSTRUCTION]
C. Thery, A. Peter, and M. Pfister 11 Feb. 1970 85 p refs In FRENCH
(ISL-T-2/70) Avail: NTIS

The performance of N-wave generator, based on the functional principle of a variable cross section shock tube, is considered for application in laboratory model studies on interactions between airplane booms and obstacles. Investigated are the effects of sonic boom at various angles of incidence on the shell of a building. Shell phases are described qualitatively, and if possible quantitatively. Results are compared with measurements obtained at various building sides. Finally, the overall effective load for the structure is determined; shadow photographs and interferometers of the process are shown. Author

N71-12248# Advisory Group for Aerospace Research and Development, Paris (France). Flight Mechanics Panel.
V/STOL HANDLING QUALITIES CRITERIA. 1: CRITERIA AND DISCUSSION
Dec. 1970 50 p refs Revised
(AGARD-R-577-70) Avail: NTIS

Criteria on handling qualities for VTOL and STOL aircraft are presented. Included with each criterion is a discussion pointing out the pilot's reasons for including a particular handling quality feature. The criteria are based on results of tests using piloted ground-based simulators, variable stability aircraft, particular models of VTOL and STOL aircraft, and variable stability helicopters. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N71-12249*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A WEIGHT COMPARISON OF ELECTROCHEMICAL DEVICES AND TURBINE-TYPE APU's FOR SPACE SHUTTLE ORBITER NON-PROPULSIVE POWER
Norman H. Hagedorn and Lyle O. Wright Nov. 1970 23 p refs
(NASA-TM-X-52938) Avail: NTIS CSCL 10B

A weight comparison was made between this system and hypothetical ones using fuel cells or batteries to replace the turbine APU. Consideration was given to mechanical power transmission via electric motors as well as hydraulic transmission. For hydraulic transmission, use of fuel cells plus a turbine APU led to a lower total system weight. Electrical motors with low specific weight fuel cells were comparable in weight to hydraulic systems with APU power sources. Author

N71-12250*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A DESIGN OPTIMIZATION OF AN OUT-OF-CORE THERMIONIC CONVERTER
Richard M. Williams 29 Oct. 1970 6 p refs Presented at the Thermionic Conversion Specialists Conf., Miami, Fla., 26-29 Oct. 1970; Sponsored by Inst. of Elec. and Electron. Engr.
(NASA-TM-X-52930; E-6051) Avail: NTIS CSCL 10B

The module is a cylindrical converter, heated and cooled by heat pipes with an integral finned radiator. Performance data illustrating the dependence of electrode efficiency and power density on emitter and collector temperature are used as input data. Design parameters such as electrode thickness and area, and current voltage operating points are varied, and the minimum specific weight is determined. For fixed converter designs, the sensitivity of performance to changes in heat pipe vapor temperature, electrical load, and radiator area is also explored. Author

N71-12251*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FABRICATION AND EVALUATION OF AN OUT-OF-CORE THERMIONIC CONVERTER MODULE
Erich W. Kroeger 29 Oct. 1970 8 p refs Presented at the Thermionic Conversion Specialists Conf., Miami, Fla., 26-29 Oct. 1970; Sponsored by Inst. of Elec. and Electron. Engr.
(NASA-TM-X-52934; E-6066) Avail: NTIS CSCL 10B

The mechanical design, fabrication procedure, and preliminary test results obtained for an out-of-core thermionic converter module,

heated and cooled by heat pipes are presented. The mechanical and thermal evaluation of critical module components, including the cermet insulator, converter end structure, and collector heat pipe in the form of a vapor fin radiator, is also discussed. Author

N71-12252*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF A 2-15 KILOWATT BRAYTON POWER SYSTEM USING A MIXTURE OF HELIUM AND XENON
Richard W. Vernon and Thomas J. Miller Nov. 1970 26 p refs
(NASA-TM-X-52936; E-6070) Avail: NTIS CSCL 10B

A Brayton power system was operated successfully for a total of 2561 hours in a vacuum environment. Two rotating units were tested and compared. With the exception of the heat source and heat sink, the components were flight-type hardware. With the design working fluid (a mixture of helium and xenon with a molecular weight of 83.8), an alternator gross output of 11.9 kilowatts was obtained. The corresponding gross and net conversion efficiencies were 0.33 and 0.29 respectively. Data are presented for turbine inlet temperatures from 1300 to 1600 F, compressor outlet pressures from 25 to 44 psia, and compressor inlet temperatures from 45 to 94 F. Author

N71-12253*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Robert F. Astrin and Martin G. Klein Washington NASA Nov. 1970 101 p
(Contract NAS3-10948)
(NASA-CR-1683; EOS-4007) Avail: NTIS CSCL 10B

The objectives of this program were to evaluate the processes, materials, and components that limit the cycle life of regenerative hydrogen-oxygen fuel cells. A composite capillary matrix was developed, tested, and demonstrated to be superior to fuel-cell-grade asbestos and other more commonly used matrix materials. Matrix materials were evaluated. Extended cycle testing, followed by examination of the components of several cells, demonstrated that platinum metal migrates from the oxygen electrode into the matrix. X-ray diffraction analyses of several matrices showed changes in the crystalline form and the uniformity of composition after extended cycling. For the electrode and matrix combination found to be best for the regenerative fuel cells, operation at 80 C exhibited considerably better cycle life than cells cycled at 50 C. Author

N71-12254*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
SIZING A SOLAR ELECTRIC THRUST SUBSYSTEM
T. D. Masek 15 Nov. 1970 17 p refs
Contract NAS7-100)
(NASA-CR-111580; JPL-TR-32-1504) Avail: NTIS CSCL 10B

A simple method for determining the approximate mass and dimensions of a solar electric thrust subsystem is presented. Each system element is discussed in terms of mass, and efficiency or power. Results are presented as a function of the power into the power conditioning units. The dependence of the size on a given mission is shown to be a function of thrust cutoff distance and thruster throttling capability. Author

N71-12255* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMIONIC DIODE SWITCH Patent
Katsunori Shimada and Scott S. Luebbers, inventors (to NASA) Issued 6 Oct. 1970 (Filed 10 May 1968) 7 p Cl. 321-2; Int. Cl. H02m3/26, 7/46, 3/00 Sponsored by NASA
(NASA-Case-NPO-10404; US-Patent-3,532,960; US-Patent-Appl-SN-728234) Avail: US Patent Office CSCL 09A

A thermionic diode switch for use in a high-temperature region to chop the current from a high-temperature dc power source is described. The switch consists of a thermionic diode across which a potential is applied. The diode is switchable from a low-current to a high-current mode by increasing the potential above an ignition voltage level. Switching from the high-current to the low-current mode is achieved by decreasing the potential below an extinction voltage level. NASA

N71-12256*# TRW Systems Group, Redondo Beach, Calif.
STUDY AND DETERMINATION OF AN OPTIMUM DESIGN FOR SPACE UTILIZED LITHIUM DOPED SOLAR CELLS Quarterly Report
R. G. Downing, J. R. Carter, and C. N. Mc Dowell 15 Oct. 1970 32 p refs Sponsored by NASA Prepared for JPL
(Contract JPL-952554)
(NASA-CR-111579; TRW-13154-6014-R0-00; QR-5) Avail: NTIS CSCL 10B

Lithium doped solar cells were irradiated with 1 MeV electrons, and their recovery characteristics were studied. Several different processing experiments were represented in these cells, including various diffusion gases and percent of lithium coverage of the rear surface. Tungsten characteristics and capacitance versus voltage measurements were obtained as a function of time at either room temperature or 60 C. The general radiation damage and recovery characteristics of each cell group are summarized. Author

N71-12257*# Heliotek, Sylmar, Calif.
DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS Quarterly Report
P. A. Payne and H. Somberg Oct. 1970 31 p refs Sponsored by NASA
(Contract JPL-952547)
(NASA-CR-111581; QR-1) Avail. NTIS CSCL 10B

The problems associated with diffusion using a BBr3 source in an inert ambient were reviewed. The problems included: 1) inconsistent results with respect to both the visual appearance and sheet resistance measurements of cell blanks from one diffusion to the next; 2) nonuniformity in the electrical characteristics as the number of cells per diffusion was increased above ten; and 3) rapid depletion of the liquid source in the bubbler and, consequently, increased cost for the source. Typical efficiencies of 10.5% to 11.0% can be obtained with cells lithium diffused eight hours at 325 C; however, two problems have become apparent which cause lower efficiencies. One of the problems, a soft knee, can be eliminated by etching the cell edges. The other problem, tunneling or internal field emission, was found to occur not only in cells lithium diffused eight hours at 325 C, but also in varying degrees in cells with other lithium diffusion parameters and 1 ohm cm P/N cells with no lithium. However, only cells lithium diffused eight hours at 325 C exhibited the excessive current between 0 and 0.1 volt in reverse bias and the shunted characteristics in the forward direction when illuminated. Author

N71-12258* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
UMBILICAL DISCONNECT Patent
Russell E. Clickner, Jr., inventor (to NASA) Issued 3 May 1966 (Filed 3 Apr. 1964) 7 p Cl. 89-1.7
(NASA-Case-XLA-00711; US-Patent-3,249,012; US-Patent-Appl-SN-357334) Avail: US Patent Office CSLC 01E

A remotely actuated quick disconnect mechanism is described for umbilical cables used in energy transfer from a ground source to a rocket propelled vehicle ready for launching. The mechanism is lightweight, reliable, and explosively actuated. E.C.

N71-12259* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REMOTE CONTROLLED TUBULAR DISCONNECT Patent
Joseph D. Pride, Jr. and William E. Zorumski, inventors (to NASA) Issued 3 May 1969 (Filed 3 Apr. 1964) 3 p Cl. 89-1.7
(NASA-Case-XLA-01396; US-Patent-3,249,013; US-Patent-Appl-SN-357336) Avail: US Patent Office CSCL 01E

A device is described for remotely actuated quick disconnect of tubular umbilical conduits employed to transfer a flowable medium from a ground source to a rocket propelled vehicle which is loaded and ready for launching. The disconnect assembly is attached to the terminal end of an umbilical conduit, and includes a male connective element. The male element is provided with an open tubular protuberance adapted to be positioned within a utilization port in the side of the vehicle. When positioned through the utilization port in the vehicle sidewall, the tubular protuberance enters a female receptacle for frictional connection. A circumferential sleeve is secured about the male element adjacent to the protuberance base. A pair of explosively driven pistons are provided in the sleeve to disconnect the male and female elements. R.B.

N71-12260* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANTI-BACKLASH CIRCUIT FOR HYDRAULIC DRIVE SYSTEM Patent
James D. Acord, inventor (to NASA) Issued 8 Mar. 1966 (Filed 5 Feb. 1965) 10 p Cl. 69-97 Sponsored by NASA
(NASA-Case-XNP-01020; US-Patent-3,238,730; US-Patent-Appl-SN-430780) Avail: US Patent Office CSCL 01E

A reversible drive system for accurately controlling movement of a load is described. The system is substantially free of backlash and comprises: (1) dual hydraulically operated drive motors engaged with the load; and (2) a means for varying the torque of one of the motors so that it acts as a variable drag on the driven load. This means includes a hydraulic circuit with primary and secondary controls. The primary control is for the direction and quantity of fluid flow; the secondary control includes an adjustable fluid pressure reduction capability in the supply line of the lower torqued motor. Load control is significantly improved and wear on the drive machinery greatly reduced due to the anti-backlash circuit. E.G.

N71-12261*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF SOLDERED AND CEMENTED COVER GLASS SILICON SOLAR CELLS
Jacob D. Broder Washington Nov. 1970 13 p refs
(NASA-TM-X-2137; E-5699) Avail: NTIS CSCL 10B

A method was developed for mounting protective glass covers on solar cells. This method eliminates the need for an adhesive and an ultraviolet protective filter. It consists of soldering the glass to the cell. Matching grid patterns are deposited on the cell and cover glass, after which both are solder dipped. They are then mated and heated to achieve the bond. This combination is equal in performance to the standard cemented cover glass cell in humidity stability and temperature cycling. It is more resistant to radiation damage primarily because of its higher blue response short-circuit current. Author

N71-12262# Army Foreign Science and Technology Center, Washington, D.C.
A THERMOELECTRICAL COOLER FOR PHOTOMULTIPLIERS
V. K. Garachuk et al 17 Jul. 1970 8 p refs Transl. into ENGLISH from Kholod. Tekh. Tekhnol. (Kiev), no. 4, 1967 p 102–105
(AD-712338; FSTC-HT-23-413-70) Avail: NTIS CSCL 13/1

The purpose of the work performed was to produce two thermoelectric coolers for photomultipliers for operation in a vacuum. Thermoelectric methods of cooling made it possible to create small dimensioned, low-temperature sources of refrigeration that are convenient for use and easy to control. A thermal battery with ring commutator was designed which made it possible considerably to decrease the heat influx to the object being cooled, dispense with heat insulation, and to decrease the dimensions of the microcooler. This system of commutation excludes the formation of a magnetic field within the cooled space. Author (TAB)

N71-12263# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NICKEL-CADMIUM BATTERIES
V. Tenkovtsev et al 10 Aug. 1970 11 p Transl. into ENGLISH from Radio (Moscow), no. 6, 1968 p 57–59
(AD-713047; FTD-HT-23-413-70) Avail: NTIS CSCL 10/3

When compared with dry manganese-zinc cells, sealed nickel-cadmium batteries have a large number of advantages. With the same size they have approximately 1.5 greater capacity, double the shelf life (in this connection considerably less internal resistance), and a small range of voltage fluctuation during operation of the equipment. The batteries are designed for repeated recharging (no less than 100 cycles), which makes them advantageous from an economic standpoint. It suffices to say, the cost of one watt-hour of energy of the TsNK-0.45 battery, widely used in hearing aids, for example, amounts to only 0.14 kopecks, while in the 316 dry cells it goes up to 29 kopecks. It should be noted that the actual service life of the batteries is 3-4 times more than the service life indicated in the technical specifications, which increases their economy even more. All these advantages of batteries over dry cells permits recommending them to be widely used as transistor-radio power supplies. Author (USGRDR)

N71-12264# Institute of Nuclear Research, Warsaw (Poland).
CRITICAL CHANNEL LENGTH OF THE HALL-TYPE MHD GENERATOR
Z. Celinski 1970 21 p refs
(INR-1159) Avail: AEC Depository Libraries

When the gas parameters vary strongly along the channel, the critical length of the Hall generator may appear. Its magnitude depends on the distribution functions of the gas parameters. With the increase of the generator duct above the critical length, the produced electrical power will be decreased. The considerations were completed by the numerical calculations for the assumed distribution functions of the gas velocity, gas conductivity, and the Hall parameter. End effects were also taken into account in the calculations. Author (NSA)

N71-12265*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE EVALUATION OF A 4.59-INCH RADIAL-INFLOW TURBINE WITH AND WITHOUT SPLITTER BLADES
Samuel M. Futral, Jr. and Charles A. Wasserbauer Washington Dec. 1970 20 p ref
(NASA-TN-D-7015; E-5874) Avail: NTIS CSCL 21E

Tests were conducted on the same turbine with and without splitter blades. Removal of the splitter blades resulted in a 0.6 point increase in total efficiency and a 0.7 point increase in static efficiency at design speed and pressure ratio. No significant change in flow rate was detected. Three computer programs were used to supplement the experimental results. Computer results indicate a flow eddy near blade leading edges with splitters removed. Author

N71-12266*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE EVALUATION OF BRAYTON SPACE POWER SYSTEM 400-HERTZ INVERTERS
Arthur G. Birchenough and Richard R. Secunde Washington Dec. 1970 17 p refs
(NASA-TM-X-2141) Avail: NTIS CSCL 10B

Two flight prototype 400-Hz three-phase quasi-square-wave inverters were tested for design and off-design performance. These static inverters, designed to produce a large current surge for motor starting, supplied up to 18 A steady state per phase at a nominal 25 V (L-N, unregulated) from a 56-V dc supply. The quasi-square-wave output was designed to produce no third-harmonic distortion. The measured efficiency with the design load was approximately 80 percent. The circuit included a pulse-triggered start-stop circuit and a proportional drive system to increase the overload capability. Author

N71-12267*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF FAILURE MODES AND REDESIGN OF SERT 2 GIMBAL PIN PULLER
David D. Renz, Ralph J. Zavesky, and Evert B. Hurst Washington Nov. 1970 13 p
(NASA-TM-X-2128; E-5864) Avail: NTIS CSCL 13G

During vibration testing of the SERT 2 spacecraft, a failure of pin pullers prompted a testing program to determine the basic failure mode and to redesign the unit. By the use of high-speed motion pictures during vibration testing it was determined that the combination of torsional and axial loading failed the shear pin. It was also discovered that the testing sequence governed the failure mode. This frictional loading was reduced and the galling was eliminated by inserting a nylon bushing between mating parts. The shear pin was relocated behind the piston-and-pin assembly to eliminate the torsional failure mode. Author

N71-12268# European Space Research and Technology Center, Noordwijk (Netherlands).
SILVER/CADMIUM AND SILVER/ZINC BATTERIES FOR SPACE-FLIGHT APPLICATION
G. Seibert May 1969 36 p refs
(ESRO-TM-139-ESTEC) Avail: NTIS

The capabilities and major limitations of silver/cadmium and silver/zinc batteries in their hermetically sealed form are discussed. The performance characteristics at different temperatures of the 5 Ah Ag/Cd battery used in the Heos satellite and the problems of charge control experienced with the Heos two-step charge regulator are described. A cycling life experiment for determining the capacity loss and change in characteristics as a function of the number of cycles was carried out on 15 Ah Ag/Cd cells. A capacity loss of 35 per cent after 1200 cycles of 14 per cent depth of discharge was found at 0 C and about a third of it was recoverable by a deep discharge cycle. The short cycling life of Ag/Zn batteries and possible improvements are also discussed. Author (ESRO)

N71-12269# Dortmund Univ. (West Germany).
A PHYSICOCHEMICAL INVESTIGATION OF THE Cu-S SYSTEM First Progress Report: 25 April 1969 - 24 October 1969
H. Rickert and H. Mathieu Paris ESRO Jan. 1970 45 p refs
(Contract ESTEC-617/68sl)
(ESRO-CR-14; PR-1) Avail: NTIS

This report describes the coulometric titration of a Pt/Cu/CuBr/Cu sub x S/Pt cell, and analyses of the electrochemical and thermodynamic behaviors of copper/aqueous solution of copper ions and sulphur/aqueous solution of sulphur ions systems. Author (ESRO)

N71-12270# European Space Research and Technology Center, Noordwijk (Netherlands).
ADVANCED SOLAR CELL ARRAY CONCEPTS
Klaus K. Reinhartz Aug. 1969 23 p refs Presented at the 6th ESRO Summer School, Noordwijk, Neth., 1968
(ESRO-TN-80) Avail: NTIS

Power requirements for spacecraft are continually increasing so advanced design concepts are essential and the areas of potential improvements are discussed. If the power-to-weight ratio is to be increased to 40 W/kg, not only must the solar cell performance be improved but also new designs for the structure of the panels in the array must be realised. The basic problems in the design of lightweight arrays are discussed and some advanced development projects for arrays with silicon and with thin-film solar cells are described. Author (ESRO)

N71-12271*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF DIFFUSION REDISTRIBUTION OF PHOSPHORUS ON THE CHARACTERISTICS OF SILICON SOLAR CELLS
Harold E. Kautz Washington Dec. 1970 14 p refs
(NASA-TM-X-2142; E-5887) Avail: NTIS CSCL 10B

Shallow junction solar cells fabricated by redistribution, with and without final phosphorus exposure where compared to standard saturation diffused cells. Cells from both types of redistribution had higher short wavelength response than saturation cells of the same sheet conductance. Redistribution alone produced the highest response. All cells exhibit the low fill factors of shallow junctions. Redistribution in deep junction cells did not enhance short wavelength response. Redistribution cells exhibited similar forward resistances to saturation diffused cells and had higher sheet conductance. Author

N71-12272*# Allis-Chalmers Mfg. Co., Greendale, Wis. Advanced Electrochemical Products Div.
CAPILLARY MATRIX AND FUEL CELL DEVELOPMENT STUDY, PART 1 Final Report
R. Michel 17 Sep. 1970 147 p refs
(Contract NAS9-10443)
(NASA-CR-108757; Doc-80045-165-Pt-1) Avail: NTIS CSCL 10B

The results of extended life fuel cell development are documented. Major efforts were concentrated on developing improvements in the stack which would extend life toward 10,000 hours and improve performance for better voltage power control. The effort centered around the fuel cell matrix, electrodes water removal methods, and electrolyte concentration gradients. Major accomplishments are listed. Author

N71-12273*# Allis-Chalmers Mfg. Co., Greendale, Wis. Advanced Electrochemical Products Div.
CAPILLARY MATRIX AND FUEL CELL DEVELOPMENT STUDY, PART 2 Final Report
R. Michel 17 Sep. 1970 130 p refs
(Contract NAS9-10443)
(NASA-CR-108758; Doc-80045-165-Pt-2) Avail: NTIS CSCL 10B

A detailed review of current systems was performed which indicates that significant reductions in system weight can be achieved without employing high risk design changes. Author

N71-12274*# Allis-Chalmers Mfg. Co., Greendale, Wis. Advanced Electrochemical Products Div.
CAPILLARY MATRIX AND FUEL CELL DEVELOPMENT STUDY, APPENDIX Final Report
R. Michel 17 Sep. 1970 88 p refs
(Contract NAS9-10443)
(NASA-CR-108759; Doc-80045-165-App) Avail: NTIS CSCL 10B

The test benches involved are numbers 220-1, 2, and 3; 230-1, 2, and 3; and 240-1, 2, and 3. The aforementioned test benches have currently been modified per updated design requirements. Modifications of the test benches incorporate the cold plate temperature control method for stabilizing cell temperature. Each test bench has the capability for semiautomatic operation which eliminates the need for 24 hour test operator surveillance. An automatic shutdown for any test bench will result if the value of any one of five parameters exceeds or falls below predetermined set limits. The five parameters are cell voltage, cell temperature, hydrogen reactant pressure, oxygen reactant pressure, and water cavity pressure. Provisions were made to retain the cause of shutdown. Author

N71-12275# Sandia Corp., Albuquerque, N.Mex.
STATISTICAL ANALYSIS OF A TEST FOR DETERMINING THE STATE-OF-CHARGE OF ZINC-MERCURIC OXIDE PRIMARY BATTERIES

Robert G. Easterling and Samuel C. Levy Jun. 1970 66 p ref
(SC-RR-70-333) Avail: NTIS

A nondestructive test was developed for determining the capacity remaining in zinc-mercuric oxide batteries. The effects of rate, temperature, and extent of discharge as well as temperature of storage on this test and on performance were determined. The test is described and the results of a statistically designed experiment are given in a previous report. This report gives the details of the statistical analysis of that experiment. NSA

N71-12278# Sandia Corp., Albuquerque, N.Mex.
A TEST FOR DETERMINING THE STATE-OF-CHARGE OF ZINC-MERCURIC OXIDE PRIMARY BATTERIES
Samuel C. Levy and Frederick W. Reinhardt Jun. 1970 25 p ref
(SC-RR-70-332) Avail: NTIS

A nondestructive test has been developed for determining the capacity remaining in zinc-mercuric oxide primary batteries. The effects of discharge rate, discharge temperature, and storage temperature upon the test and upon battery performance were studied. Author

N71-12277*# Electro-Optical Systems, Inc., Pasadena, Calif.
DEVELOPMENT OF THERMIONIC CONVERTERS Final Report
Dean Jacobson and Randy Hamerdinger Oct. 1970 322 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952255)
(NASA-CR-111578) Avail: NTIS CSCL 10B

Six ring-type cylindrical thermionic converters were designed, fabricated and tested in an iterative manner during this developmental program. Converters with characteristic low power and high efficiency were designed to be capable of integration to form a modular power supply of high power output. The central philosophy of the approach was to increase the reliability of thermionic space power supplies by redundancy of the basic component. The improved cylindrical converters had an ultimate optimum performance of 3.86 watts/sq cm, at 0.50 volt, at a measured emitter hohlraum temperature of 1400 C. The calculated interelectrode spacing at 1400 C was 12 mils. The final converter design featured a conical emitter envelope with a convolute for added strength, and a total converter thickness of 1.52 cm. The emitter and collector materials were CVD or wrought rhenium and the radiator was solid niobium. Author

N71-12278*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF RADIATION ON CERIUM-DOPED SOLAR-CELL COVER GLASS
Gilbert A. Haynes Washington Dec. 1970 14 p refs
(NASA-TN-D-6024; L-7323) Avail: NTIS CSCL 10B

The results of an investigation to determine the feasibility of using an inexpensive, radiation-resistant solar-cell cover glass to replace synthetic fused quartz are reported. Several samples of a frequently used solar-cell cover glass were doped with various amounts of cerium. These samples were irradiated with 1 MeV electrons to a maximum fluence of 5 × 10 to the 14th power electrons per square centimeter and with 22 MeV protons to a maximum fluence of 10 to the 13th power protons per square centimeter. The effects of the electrons and protons used in this investigation are representative of those of the corpuscular radiation found in space. Cerium doping of the cover glass improves its radiation resistance. The optimum level of cerium doping appears to be between 1 and 2 percent by weight. Author

N71-12279# Radio Corp. of America, Lancaster, Pa. Electronic Components.
ADVANCED HEAT PIPE THERMIONIC TECHNOLOGY. TOPICAL REPORT, TASK 2: DEVELOPMENT OF ADSORPTION RESERVOIR, 1 MARCH TO 30 SEPTEMBER 1969
R. A. Freggens 30 Sep. 1969 48 p
(Contract AT(30-1)-3979)
(NYO-3979-4) Avail: NTIS

Work performed on the development of an integral adsorption reservoir thermionic converter is described. Three general areas were investigated during the study including cesium purification, material processing, and integral reservoir converter fabrication. The cesium purification employed a high temperature reaction to remove halide compounds. A study was also made to develop a large surface to volume ratio in a molybdenum matrix. Variations in time, temperature, and atmosphere for sintering the matrix were used as the basis of the study. The RCA A-1279 thermionic converter was modified to include an integral matrix reservoir and designated the RCA A-1345. The modified design included 80 cu cm of reservoir matrix integrally located within the converter. The device was fabricated, processed, and electrically life tested using its own internal cesium reservoir for a period of 380 hours before the heat pipe-heat source failed forcing termination of the test. Author (NSA)

N71-12576# European Space Research Organization, Paris (France).
PROCEEDINGS OF THE SIXTH ESRO SUMMER SCHOOL. VOLUME 11: SPACE POWER SYSTEMS: POWER CONDITIONING AND CONTROL
Nov. 1969 148 p refs Partly in ENGLISH and partly in FRENCH Conf. held at Noordwijk, Neth., 1968
(ESRO-SP-50) Avail: NTIS

CONTENTS:

1. ELECTRONIC CONTROL CIRCUITS FOR POWER SUPPLIES J. J. Capart (ESRTC) p 1–28 refs (See N71-12577 03-03)

2. POWER DISTRIBUTION B. Le Heritte (Sogam-Electronique) p 31–72 refs (See N71-12578 03-03)

3. AUXILIARY CIRCUITS AND POWER SYSTEM PERFORMANCE ANALYSIS A. Werner Preukschat (ESRTC) p 75–95 refs (See N71-12579 03-03)

4. PROGRESS IN THE DESIGN OF ELECTRONIC CIRCUITS FOR SATELLITE POWER SYSTEMS J. J. Capart (ESRTC) p 97–120 refs (See N71-12580 03-03)

5. ELECTROMAGNETIC INTERFERENCE CONTROL IN SPACECRAFT DESIGN M. Berkowitz (GE, Philadelphia) p 123–141 refs (See N71-12581 03-03)

N71-12577# European Space Research and Technology Center, Noordwijk (Netherlands).
ELECTRONIC CONTROL CIRCUITS FOR POWER SUPPLIES [CIRCUITS ELECTRONIQUES DE COMMANDE DES SOURCES D'ENERGIE]
J. J. Capart *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 11: Space Power Systems: Power Conditioning and Control Nov. 1969 p 1–28 refs In FRENCH (See N71-12576 03-03)
Avail: NTIS

Some of the electronic circuits necessary for the power supply of satellites are used to command, stabilize and protect the power sources. A brief description of these circuits is given forming an analysis of the main factors to be considered. The most frequently used regulating circuits are then described and the different ways of connecting them to the sources are discussed. The results gained are listed. ESRO

N71-12578# Sogam-Electronique, Poissy (France).
POWER DISTRIBUTION [DISTRIBUTION DE LA PUISSANCE]
B. Le Heritte *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 11: Space Power Systems: Power Conditioning and Control

Nov. 1969 p 31 72 refs In FRENCH (See N71-12576 03-03)
Avail: NTIS

The power gained by satellite solar cells has to be distributed among a great number of circuits which have different needs as to voltage regulation and filtering. This variety of requirements, as well as the necessity to avoid any load interferences, imposes the design of a complex power distribution system. Different basic circuits for regulation and voltage conversion are presented. The choice between direct and alternating current and some performance criteria are discussed. ESRO

N71-12579# European Space Research and Technology Center, Noordwijk (Netherlands).
AUXILIARY CIRCUITS AND POWER SYSTEM PERFORMANCE ANALYSIS
A. Werner Preukschat *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 11: Space Power Systems: Power Conditioning and Control Nov. 1969 p 75 95 refs (See N71-12576 03-03)
Avail: NTIS

An introduction to power system performance analysis is given. The measurement techniques requiring auxiliary circuits are briefly discussed. From an analysis of the interface between system units the requirements for performance evaluation are derived. The requirements for a ground evaluation facility and its components are outlined; a possible solution to the problem of performance analysis in flight is indicated. Author (ESRO)

N71-12580# European Space Research and Technology Center, Noordwijk (Netherlands).
PROGRESS IN THE DESIGN OF ELECTRONIC CIRCUITS FOR SATELLITE POWER SYSTEMS
J. J. Capart *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 11: Space Power Systems: Power Conditioning and Control Nov. 1969 p 97 120 refs (See N71-12576 03-03)
Avail: NTIS

The requirements of future unmanned space missions are reviewed. The methods used to improve the power conditioning are divided into two groups. The first consists of the optimization of the working parameters of the circuits and of the selection of the best configuration for a given mission, based on the state-of-the-art technology in the design of converters and regulators. The second category is concerned with new developments: as examples, some new circuit principles are described and their advantages given. Author (ESRO)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N71-12285 Michigan Univ., Ann Arbor.
A MATHEMATICAL MODEL OF SPINAL RESPONSE TO IMPACT
David Orne (Ph.D. Thesis) 1969 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-4163

A discrete-parameter model of the human body under a variety of impact situations was developed, emphasizing the spine as the main load-carrying element. The model simultaneously accounts for axial, shear and bending deformations of the discs; the viscoelastic behavior of the discs, the variable size of the vertebrae and discs, the natural curved shape of the spine, and the eccentric inertial loading caused by the head and trunk. The loading is a trapezoidal acceleration pulse applied via pelvis, at a general angle in the sagittal plane. The vertebrae and the intervertebral discs are simulated by a sysem of alternately rigid and deformable segments arranged to describe the natural curvature of the spine. Distributed body masses are attributed to the rigid segments, each of which has three degrees of freedom in the sagittal plane. A digital computer program, using a Runge–Kutta integration algorithm, was used for the solution. The model is potentially a useful tool for the prediction and control of spinal injuries produced under various impact situations. Dissert. Abstr.

N71-12286# Istituto di Fisica dell'Atmosfera, Rome (Italy).
ON A FEW MODIFICATIONS OF THE AIR CHARACTERISTICS DUE TO AID CONDITIONING INSTALLATIONS [STUDIO SU UPCUNE CARATTERISTICHE FISICHE DELL' ARIA IN UN AMBIENTE CONDIZIONATO]
Giuseppe Dalu Apr. 1969 33 p refs In ITALIAN
(IFA-SR-26) Avail: NTIS

The influence of air conditioning systems on personnel was analyzed and an explanation of ill-health sensations was sought. Oxygen concentration, air temperature, humidity, illumination, ion concentration, electric conductivity and condensation nuclei measurements were made but no conclusions were reached. ESRC

N71-12287# Human Engineering Labs., Aberdeen Proving Ground, Md.
ANCHORING LINES AND THE MUELLER-LYER ILLUSION
Lloyd L. Avant and Mike Kent Jul. 1970 13 p refs
(AD-712981; HEL-TN-6-70) Avail: NTIS CSCL 6/16

Using the method of pair comparisons, subjects judged 12 stimulus configurations comprised of horizontal Mueller-Lyer (M-L) figures bordered above and below by shorter or longer anchoring lines. From the pooling model of adaptation-level theory, it was predicted that perceived length of the M-L figures would be assimilated toward anchor length. Results confirmed the prediction. Author (TAB)

N71-12288# Naval Air Engineering Center, Philadelphia, Pa. Aerospace Crew Equipment Lab.
PHYSIOLOGICAL EVALUATIONS OF ARTIFICIAL SPACECRAFT ATMOSPHERES
Edwin Hendler 1970 21 p refs
(AD-712559) Avail: NTIS CSCL 6/19

The results of physiological evaluations of artificial spacecraft atmospheres carried out over an eight year period are summarized. The atmospheres studied include those consisting of pure oxygen and mixed gas (oxygen-nitrogen); additional factors evaluated include simulated launch and reentry accelerations, decompression, and exercise. Findings regarding changes in pulmonary function and incidence of decompression sickness are discussed in term of exposurg duration, sequence of applied stresses, and objective and subjective responses. The importance of individual reactions to imposed stresses is pointed out by particular examples, and the relations of such reactions to formulating judgments on the suitability of specific atmospheres are discussed. Author (TAB)

N71-12289# Human Engineering Labs., Aberdeen Proving Ground, Md.
ANCHORING STIMULI AND TITCHENER'S ILLUSION
Kathleen Wagner (Iowa State Univ.) and Lloyd L. Avant (Iowa State Univ.) Jul. 1970 10 p ref
(AD-712982; TN-7-70) Avail: NTIS CSCL 6/16

In a series of Titchener illusion figures, control subjects were asked to report the larger - center or surrounding - circles when the ratio of surrounding to center circle diameter varied, in .05 steps, from .75 to 1.25 across series members. Experimental subjects judged these series members, alternated with a stimulus configuration, in which the ratio of diameters was either .20 or 1.80. In both experimental groups, shifts in center-surrounding circle

PSE and changes in judgments of series members were consistent with predictions drawn from the pooling model of AL theory.
Author (TAB)

N71-12290# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD SPECIALIST'S MEETING ON BLOOD CIRCULATION AND RESPIRATORY FLOW
J. F. Gross and K. Gersten Dec. 1970 16 p refs Conf. held at Naples, 4 - 6 May 1970
(AGARD-AR-30-70) Avail: NTIS

The purpose, scope, and results of an interdisciplinary meeting dealing with sciences in the field of fluid mechanics and in medicine are reviewed. The review shows a need for engineers and physicists to coordinate their efforts in fluid mechaics research. New insights are given for the behavior of all fluids in living systems.
Author

N71-12291# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NATIONAL ESTIMATE OF PUBLIC AND INDUSTRIAL HEAT REJECTION REQUIREMENTS BY DECADES THROUGH THE YEAR 2000 AD
R. T. Jaske, J. F. Fletcher, and K. R. Wise Feb. 1970 23 p refs Presented at the 67th Natl. Meeting of the Am. Inst. of Chem. Engr., Atlanta, 17 Feb. 1970 *Its* AIChE Paper No. 37A
(Contract AT(45-1)-1830
(BNWL-SA-3052; CONF-700212-1) Avail: NTIS

Reduction of heat emission into the atmosphere is discussed. Trends in plant thermal efficiency for the present and the future are also examined. A national energy policy is proposed using tax incentives for the elimination of disposable containers, internal combustion engine, uninsulated structures, incineration of wastes and nonregenerative air conditioning systems.
J.A.M.

N71-12292# Human Engineering Labs., Aberdeen Proving Ground, Md.
COLOR AND SUBJECTIVE DISTANCE
Claude N. McCain, Jr. and A. Charles Karr Aug. 1970 16 p refs
(AD-712984; HEL-TM-20-70) Avail: NTIS CSCL 6/16

Sixteen observers adjusted the position of white or colored rod until it seemed to be alongside a reference white or colored rod. The colors used were blue and red of matched luminances. Observers tended to see the red rods as nearer and the blue rods as further away. It was concluded that red and blue are used as cues for depth perception.
Author (TAB)

N71-12293# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
SOME ACUTE AND CHRONIC EFFECTS OF ENDRIN ON THE BRAIN
Alvin M. Revzin Jul. 1970 14 p refs
(FAA-AM-70-11) Avail: NTIS

The data presented suggest that aerial applicator personnel exposed to endrin may be subject to two hitherto undefined toxic risks: (1) sensory disturbances which may appear after acute exposure at doses too low to produce tremors and other gross signs of poisoning; and (2) under some circumstances, endrin stored in body fat may be released in amounts sufficient to cause poisoning. The effects of endrin on the brain were determined in anesthetized pigeons and in nonanesthetized squirrel monkeys with chronically implanted electrodes.
Author

N71-12294*# Mayo Association, Rochester, Minn.
STUDIES OF THE EFFECTS OF GRAVITATIONAL AND INERTIAL FORCES ON CARDIOVASCULAR AND RESPIRATORY DYNAMICS Semiannual Status Report
1 Oct. 1970 41 p refs
(Grant NGR-24-003-001)
(NASA-CR-111606) Avail: NTIS CSCL 06S

The reproducibility and accuracy of the biplane roentgen videometry system developed for dynamic (60 per second) measurements of the shape and volume of the left ventricle in intact animals and man are discussed. The effects of the magnitude and duration of the gravitational-inertial force environment on intrathoracic pressure relationships and the consequent alterations in the spatial distribution of pulmonary blood flow are considered. The effects of water immersion and breathing liquid fluorocarbon on the cardiopulmonary effects of acceleration are investigated.
Author

N71-12295*# California Univ., San Diego.
[MICRODOSIMETRY AND RADIOLOGY] Annual Report, 1 Oct. 1969 - 30 Sep. 1970
Norman A. Baily 30 Sep. 1970 69 p refs
(Grant NGL-05-009-103)
(NASA-CR-111820) Avail: NTIS CSCL 06R

Research progress is reported on the distribution in size of the energy depositions representing single events in volumes of biological significance when high energy charged particles cross such a volume and the spatial distribution of the secondary particles released by such events. Theoretical approaches to microdosimetry, radiobiology, and a single-scan television system are also discussed.
R.B

N71-12296*# Houston Univ., Tex.
DEVELOPMENT OF LUNAR RECEIVING LABORATORY BIOLOGICAL PROTOCOL Final Report, 1 Jul. 1968 - 31 Aug. 1970
S. Venketeswaran 30 Oct. 1970 82 p refs
(Contract NAS9-8264)
(NASA-CR-108764) Avail: NTIS CSCL 06C

Selection of specific algae, seeds, and seedlings of higher plants and establishment of tissue cultures of plants of economic importance are discussed. The supplying of 40 to 50 tissue culture media of each of 8 representative plants and the same number of initial tissues of each of the 8 species is reported.
Author

N71-12297# RAND Corp., Santa Monica, Calif.
FIFTY ENVIRONMENTAL PROBLEMS OF TIMELY IMPORTANCE
L. M. Libby Sep. 1970 70 p refs
(AD-712722; D-4415) Avail: NTIS CSCL 13/2

The paper surveys some of the most recognizable and pressing problems of the environment, and includes comments on them from the current literature. Topics include short articles on pollution involving SST and stratospheric air force planes, Heat, DDT, Airports, Design of satellite-city systems, Respiratory diseases and smog, Radioactive waste disposal methods, Constructive use of garbage, Indemnity payments by air polluters, Phosphorus in waste waters, Constructive use of sewage, Biologic effects of lead, Clean-up of fuel oil, Weather modification, Ocean pollution, Reuse of golf courses, graveyards, and railroad properties, City slums, Resources of continental shelves, Hot pipeline in arctic, Los Angeles and earthquakes, Weather and CO2, Dome over manhattan, Extermination genus rattus, Helium, Eutrophication, Law for pollution control, Atmospheric CO, Starfish and its control, Oil spills, Logging, Tundra lands, and Ice fog.
TAB

N71-12298# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
BIOHAZARDS MANUAL
T. A. Lincoln, N. E. Bolton, A. C. Upton, R. W. Tennant, E. F. Babelay, et al May 1970 19 p refs

(Contract W-7405-eng-26)
(ORNL-TM-2854) Avail: NTIS

The problems of laboratory-acquired infections, oncogenic viruses, allergy to animal dander and sera, and carcinogens are reviewed. A classification of infectious agents is presented, with recommendations for their containment. A few basic principles for the safe handling of hazardous agents are listed, since accidents are more likely to occur with untrained or inexperienced personnel. The containment criteria specified were established to assure safety in laboratories engaged in biological research. Author

N71-12299# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
HYDRODYNAMICS OF VISCOUS INTERNAL FLOWS WITH EMBEDDED PARTICULATE MATTER Final Report, 1967–1970
Richard Skalak Sep. 1970 5 p refs
(Contract N00014-67-A-0180-0003)
(AD-711818) Avail: NTIS CSCL 20/4

A review is given of principal technical accomplishments, along with a list of research personnel and publications. TAB

N71-12300# Stanford Univ., Calif.
[ON DETECTION OF ANTIGENS AND GENETIC ANALYSIS WITH MAN-MOUSE HYBRIDS] Progress Report
1970 54 p refs
(Contract AT(04-3)-326)
(SU-326-P-26-X-2) Avail: NTIS

Analysis of hybrids produced from a cross between human white cells and a 5BUdR resistant 3T3 cell line has provided convincing evidence for a new human autosomal linkage, namely between LDH B and Peptidase B. The products of this hybrid were assayed for 13 enzymes for which the human and mouse forms differ electrophoretically. Pairwise analysis of the association of these enzymes amongst the clonal products of the hybridization showed that the human forms of LDH B and Peptidase B were always either present together or absent together. This consistent association was confirmed in subclones of the lines derived from the initial colonies picked after hybridization. The human cell donor used in this cross was heterozygous for a peptidase D variant. This allowed the detection of segregation of the two homologous chromosomes carrying this gene into the hybrids. Thus one hybrid was found which expressed only one of the two peptidase D alleles and another was found expressing only the other allele. Statistical analysis of the results of this hybridization has provided further evidence for selection taking place during the evolution of hybrid colonies following the initial hybridization. Author (NSA)

N71-12301*# Techtran Corp., Glen Burnie, Md.
THE FUNCTIONAL SYNCHRONIZATION OF THE NEUROSECRETORY CELLS OF THE SUPRA-OPTICAL NUCLEUS OF THE DEHYDRATED AND REHYDRATED RAT: ULTRASTRUCTURAL STUDY [LA SYNCHRONIZATION FONCTIONNELLE DES CELLULES NEUROSECRETRICES DU NOYAU SUPRA-OPTIQUE DU RAT DESHYDRATE ET REHYDRATE, ETUDE ULTRASTRUCTURALE]
D. Picard Washington NASA Dec. 1970 8 p refs Transl. into ENGLISH from Compt. Rend., Ser. D (France), v. 271, no. 10, 7 Sep. 1970 p 847–850
(Contract NASw-2037)
(NASA-TT-F-13419) Avail: NTIS CSCL 06A

The presence of cells with different aspects in a single neurosecretory nucleus has been observed after the use of several optical microscopy techniques. There are two schools of thought as to the explanation for this phenomenon. The first claims that there are two categories of cells which have different hormonogenic functions. The second believes that this difference in aspect merely means that the cells being viewed constitute different stages in a cyclic secretory process. An experiment conducted on rats, involving their dehydration and rehydration with subsequent examination of the supra-optical nucleus is reported. Although it was not determined which of these theories is correct, certain basic information was generated which can be used by proponents of both theories. Author

N71-12302*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.
BIOPHYSICAL EVALUATION OF THE HUMAN VESTIBULAR SYSTEM Status Report, Jul. 1969–Sep. 1970
J. L. Meiry and L. R. Young Sep. 1970 59 p refs
(Grant NGR-22-009-156)
(NASA-CR-111607; MV-70-5) Avail: NTIS CSCL 06P

Research on the function and importance of the vestibular system is reported. Research efforts fall under the following broad categories: (1) quantitative modelling of vestibular function including interaction with the visual system; (2) the underlying physiological and neurophysiological mechanisms responsible for observed vestibular and visual responses; and (3) clinical diagnosis of disorders based on the research of vestibular function. Author

N71-12303*# National Aeronautics and Space Administration. Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SEPTEMBER 1970
Oct. 1970 126 p refs
(NASA-SP-7011(81)) Avail: NTIS CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N71-12304# Arizona Univ., Tucson. Dept. of Watershed Management.
STATISTICAL STUDY OF BASIC ECOLOGICAL VARIATIONS IN A SHORTGRASS SITE Technical Progress Report, 15 Sep. 1969–14 Sep. 1970
Charles D. Bonham 14 Sep. 1970 26 p refs
(Contract AT(11-1)-1821)
(COO-1821-2) Avail: NTIS

A study of statistical variations of ecological variables in a shortgrass site was performed in order to define important ecological variables and their variation on a geographical coordinate basis. Well-known statistical experimental designs have been useful in assessing ecological variation across a geographical surface. However, a computer mapping technique has been developed which gives more flexibility in interpretation of ecological variations across this surface. NASA

N71-12305# School of Aerospace Medicine, Brooks AFB, Tex.
COMBINED EFFECTS OF CHLORPROMAZINE AND ALTITUDE UPON PERFORMANCE IN THE RAT Technical Report, Jan.–Mar. 1970
Charles E. Dasher and Horace E. Hamilton Aug. 1970 17 p refs
(AD-712664; SAM-TR-70-46) Avail: NTIS CSCL 6/15

Four male Sprague-Dawley rats were conditioned to press a lever in response to visual and auditory cues, and to release the lever upon termination of the cues. The rodents were then tested under the conditions of saline, chlorpromazine (CPZ), altitude, and CPZ plus altitude. For each set of data, 50 trials of control data were recorded, and then the animals were either injected with saline or CPZ, or, in the case of controls, merely stuck with a needle. Twenty-five minutes after injection, an additional 50 trials were recorded. For the altitude data, the rodents were brought to

the simulated altitude 5 minutes after injection. Performance was significantly decreased by CPZ ($P < .01$) and by altitude ($P < .05$), but no CPZ-altitude interactions were observed. Saline produced no effect upon performance. Author (TAB)

N71-12306# Federation of Rocky Mountain States, Inc., Denver, Colo.

PROCEEDINGS OF WESTERN STATES CONFERENCE ON SCIENCE AND TECHNOLOGY AND ITS APPLICATION TO THE PROBLEMS OF POLLUTION, TRANSPORTATION AND EMPLOYMENT

Mar. 1970 147 p refs Held at Salt Lake City, 9 - 11 Mar. 1970
Sponsored by NSF
(PB-192329) Avail: NTIS CSCL 13B

Panel topics were: (1) science, technology, and human resources; and (2) planning science for what can be done in the future. USGRDR

N71-12307# Naval Intelligence Command, Alexandria, Va. Translation Div.

CHANGE OF MUSCULAR WORKING CAPACITY AFTER EXPOSURE OF MAN TO HYPOKINETIC CONDITIONS [IZMENENIE MYSHECHNOI RABOTOSPOSOBNOSTI POSLE PREBYVANIYA CHELOBEKA V USLOVIYAKH GIPOKINEZII]

N. I. Taranov et al 12 Oct. 1970 9 p Transl. into ENGLISH from Fiziol. Zh. SSSR (USSR), v. 51, no. 11, 1965 p 1351 - 1355
(AD-713007; NIC-Trans-3124) Avail: NTIS CSCL 6/19

During extended flights under conditions of weightlessness muscular activity will be sharply decreased as a result of reduced exertions related with maintenance and change of posture. Apparently, the capacity of man to carry out work related with physical exertion undergoes a significant change under these circumstances. Research has shown that prolonged exposure of man to decreased mobility leads to a decline in his capacity to carry out work related to the use of static exertion. The task of this work included the study of changes in the capacity of man to carry out rhythmic work in manually lifting a weight after exposure to reduced mobility and minimal muscular exertion in maintaining posture. Author (TAB)

N71-12308# Akademiya Nauk URSR, Kiev.

SOME RESULTS OF PHYSIOLOGICAL INVESTIGATIONS DURING THE FLIGHT OF THE 'SOYUZ'-9 SPACECRAFT

O. G. Gazenko and P. V. Vasilyev Oct. 1970 5 p Presented at the 21st Intern. Astronaut. Congr., Constance, W. Ger., 4 - 10 Oct. 1970
Avail: NTIS

Significant findings are presented concerning the space flight effects on the crew of Soyuz-9 examinations made both during and after the flight. During the flight the cardiovascular and repiration function, energy expenditures, the state of the central nervous system, and analyzers were assessed. Variations in work performance were examined on the basis of the results of working operations and specific tests. Three times during the 18 days the diurnal urine was sampled for analysis. Post-flight examinations ascertained the changes in body weight, bone density, blood viscosity, protein content in the blood serum, and the albumin-globulin coefficient. The results indicate the man can survive an 18-day space flight and retain mental and physical performance. The findings also suggest that the entire cycle of adaptation-readaptation to the space-earth environments places certain demands on the human body and that readaptation is a more difficult process. D.L.G.

N71-12309# Joint Publications Research Service, Washington, D.C.

ECHOLOCATION IN NATURE

E. Sh. Ayrapet Yants et al 6 Oct. 1970 42 p refs Transl. into ENGLISH from the book "Ekholokatsiya v Prirode" Nauka Publishing House; 1970 p 323 - 338, 344 - 358
(JPRS-51511) Avail: NTIS

Soviet experiments on the echolocation capabilities of dolphins are discussed. These experiments were designed to provide additional information on the capability of dolphins to distinguish objects, such as fish and rubber pipes, of various sizes. Results indicate that dolphins are capable, by perceiving the reflected signals, of recognizing objects according to size and according to the quality of the reflecting surface. A.L.

N71-12310# National Inst. of Radiological Sciences, Chiba (Japan).

[RADIOLOGICAL SCIENCE: PHYSICAL, MEDICAL, BIOLOGICAL, AND ENVIRONMENTAL STUDIES] Annual Report, 1968 - 1969

Oct. 1969 85 p refs
(NIRS-8) Avail: AEC Depository Libraries

Radiological science research is reported in four sections and includes: (1) The development of radiation detectors and dosimeters for nuclear medicine and radiation protection is summarized. (2) Brief papers or abstracts are presented for seven medical research projects. (3) Biological investigations reported include research in the areas of biochemistry, biophysics, cytology, genetics, morphology, and physiology. (4) Brief papers or abstracts are presented for five environmental research projects. D.L.G.

N71-12311# Oak Ridge National Lab., Tenn. Ecological Sciences Div.

RELATIONSHIP OF CESIUM 137 AND IRON 59 ELIMINATION RATES OF SMALL RODENTS

C. E. Baker (Ph.D. Thesis Tennessee Univ.), P. B. Dunaway, and S. I. Auerbach Jul. 1970 113 p refs
(Contract W-7405-eng-26)
(ORNL-4568; UC-48) Avail: NTIS

Elimination of Cs-137 and Fe-59 by wild rodents was measured in the laboratory and field to determine whether excretion rates of these nuclides are influenced directly by general metabolic rates. The object of this research was to establish a technique for measuring metabolism in the field for ultimate application in energy flow studies. A double-tagging method was employed, isotopes were administered intraperitoneally, and attention was focused on final-component elimination of each isotope. Long-component intercept values of Cs-137, which indicated the level of incorporation or rate of initial-component excretion, exhibited a strong correlation with CO_2 production within species. Based on this relationship, equations were derived to predict metabolism from Y-axis intercept values. These equations have potential use in estimating metabolism of rodents in the field for energy flow measurements. Although Fe-59 elimination appeared to correlate with metabolic rates in the field, laboratory experiments failed to demonstrate a predictable relationship between excretion of this nuclide and general metabolism. Author

N71-12312*# California Univ., Berkeley. Space Sciences Lab.

STUDY OF GROWTH IN RECENT AND FOSSIL INVERTEBRATE EXOSKELETONS AND ITS RELATIONSHIP TO TIDAL CYCLES IN THE EARTH-MOON SYSTEM Semiannual Report, Apr. - Sep. 1970

William B. N. Berry Sep. 1970 9 p refs *Its* Space Sci. Lab. Ser. 1'1, Issue No. 78
(Grant NGR-05-003-067)
(NASA-CR-111608) Avail: NTIS CSCL 06C

Data obtained from demonstrated and apparent growth rhythms observed in shells of fossil marine invertebrate animals are discussed with respect to their use in calculating the possible relationship of the earth and moon through prehistoric time and in postulating the possible origins of the earth-moon system. Previous authors suggested that certain fine growth increments that may be observed clustered within the major, annually formed bands reflect environmental rhythmic changes such as tides and water temperature changes coincident with the seasons. The fine growth

increments and clusters of them within the annually formed bands were investigated to find the relationship of such increments to environmental phenomena. An attempt is made to relate the features of the shells seen in living animals to similar features in the shells of fossils. Author

N71-12313*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
MECHANISMS FOR THE EFFECT OF ELECTRIC AND MAGNETIC FIELDS ON BIOLOGICAL SYSTEMS Final Report, Jun. 1967 - Sep. 1970
M. M. Labes Sep. 1970 83 p refs
(Grant NGL-39-004-015)
(NASA-CR-111582) Avail: NTIS CSCL 06A

CONTENTS:

1. INFLUENCE OF ELECTRIC FIELDS ON THE RATE OF GROWTH OF MOLECULAR SOLIDS A. Szymanski and M. M. Labes 3 p refs (See N71-12314 03-04)

2. CONDUCTIVITY IN LIQUID CRYSTALS S. Kusabayashi and M. M. Labes 11 p refs (See N71-12315 03-04)

3. RELATIONSHIP BETWEEN ELECTRIC FIELD STRENGTH AND HELIX PITCH IN INDUCED CHOLESTERIC-NEMATIC PHASE TRANSITIONS H. Baessler and M. M. Labes 3 p refs (See N71-12316 03-04)

4. ELECTRIC FIELD EFFECTS ON THE DIELECTRIC PROPERTIES AND MOLECULAR ARRANGEMENTS OF CHOLESTERIC LIQUID CRYSTALS H. Baessler and M. M. Labes 7 p refs (See N71-12317 03-04)

5. ELECTRIC FIELD EFFECTS ON THE OPTICAL ROTATORY POWER OF A COMPENSATED CHOLESTERIC LIQUID CRYSTAL H. Baessler, T. M. Laronge, and M. M. Labes 8 p refs (See N71-12318 03-04)

6. ALTERNATING-CURRENT-FIELD INDUCED CHOLESTERIC-NEMATIC PHASE TRANSITIONS H. Baessler and M. M. Labes 4 p refs (See N71-12319 03-04)

7. DIPOLE RELAXATION IN A LIQUID CRYSTAL H. Baessler, R. R. Beard, and M. M. Labes 7 p refs (See N71-12320 03-04)

8. MAGNETIC-FIELD EFFECTS ON A COMPENSATED CHOLESTERIC LIQUID CRYSTAL T. H. Laronge, H. Baessler, and M. M. Labes 3 p refs (See N71-12321 03-04)

9. THE ABSENCE OF HELICAL INVERSION IN SINGLE COMPONENT CHOLESTERIC LIQUID CRYSTALS H. Baessler, P. A. G. Malya, W. R. Nes, and M. M. Labes 10 p refs (See N71-12322 03-04)

10. HELICAL TWISTING POWER OF STEROIDAL SOLUTES IN CHOLESTERIC MESOPHASES H. Baessler and M. M. Labes 7 p refs (See N71-12323 03-04)

11. DETERMINATION OF THE PITCH OF A CHOLESTERIC LIQUID CRYSTAL BY INFRARED TRANSMISSION MEASUREMENTS H. Baessler and M. M. Labes 3 p refs (See N71-12324 03-04)

N71-12314*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
INFLUENCE OF ELECTRIC FIELDS ON THE RATE OF GROWTH OF MOLECULAR SOLIDS
A. Szymanski and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 3 p Repr. from Nature (London), v. 220, no. 5163, 12 Oct. 1968 p 159 - 161 refs (See N71-12313 03-04)
(A69-10140) Avail: NTIS CSCL 06A

Growth rates of insulating crystals were examined in the melt, solution and vapor phases and evidence was obtained that the rate of growth of an organic solid from the vapor phase can be controlled by applying a dc electric field to the growing surface. At low growth rates (0.2 micrograms/min), by applying an electric field of the order of 4,000 V/cm, it is in fact possible to prevent crystal growth. The experiments were conducted by continuous vacuum evaporation of aromatic hydrocarbons from a Knudsen cell at pressures of 5 × 0.00001 atmospheres or less with a crystal mounted on a stirrup of a Cahn RG electro-balance. Author

N71-12315*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
CONDUCTIVITY IN LIQUID CRYSTALS
S. Kusabayashi and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 11 p Repr. from Mol. Cryst. and Liquid Cryst. (Engl.), v. 7, 1969 p 395 - 405 refs (See N71-12313 03-04)
Copyright. Avail: NTIS CSCL 06A

Dark and photoconductivities of nematic, smectic and cholesteric materials were measured with particular attention to the changes in properties at phase transitions. Although a reasonably large photoresponse could be found in several liquid crystals at room temperature only a very small photoresponse occurred in the liquid crystal state. At the transition point solid yields liquid crystal the dark conductivity, sigma sub D, and the thermal activation energy, E sub a typically show large changes, while in the liquid crystal yields liquid transition sigma sub D and E sub a change only slightly. Both transition temperatures can easily be identified in the plots of log sigma vs 1/T, and agree well with microscopic and calorimetric observations. Cholesteric materials show a surprising decrease in dark conductivity at the solid yields cholesteric transition during heating, in contrast with the behavior of nematic and smectic materials. Author

N71-12316*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
RELATIONSHIP BETWEEN ELECTRIC FIELD STRENGTH AND HELIX PITCH IN INDUCED CHOLESTERIC-NEMATIC PHASE TRANSITIONS
H. Baessler and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 3 p Repr. from Phys. Rev. Lett., v. 21, no. 27, 30 Dec. 1968 p 1791 - 1793 refs (See N71-12313 03-04)
(A69-14964) Avail: NTIS CSCL 06A

A cholesteric-nematic phase transition can be induced by relatively weak electric fields, and the threshold field varies inversely with the pitch of the helix in corroboration of recent theoretical suggestions. The phase change is accompanied by a change in the activation energy for charge-carrier production and can easily be observed by both conductivity measurements and direct optical examination. Author

N71-12317*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
ELECTRIC FIELD EFFECTS ON THE DIELECTRIC PROPERTIES AND MOLECULAR ARRANGEMENTS OF CHOLESTERIC LIQUID CRYSTALS
H. Baessler and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 7 p Repr. from J. of Chem. Phys., v. 51, no. 5 1 Sep. 1969 p 1846 - 1852 refs (See N71-12313 03-04)
(A70-11352) Avail: NTIS CSCL 06A

Measurements of dielectric constants of a cholesteryl chloride - cholesteryl myristate mixture having a strongly temperature-dependent helical pitch were performed in the presence and absence of an applied dc electric field. An analysis of the molecular arrangement in samples oriented by wall effects is presented, as well as the perturbations in this arrangement which occur both thermally and by the application of an electric field. Elastic moduli of bending and torsional strain are estimated from the threshold electric fields observed to (1) induce helical perturbation and (2) destroy the helical structure in the transition to a nematic phase. Author

N71-12318*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
ELECTRIC FIELD EFFECTS ON THE OPTICAL ROTATORY POWER OF A COMPENSATED CHOLESTERIC LIQUID CRYSTAL
H. Baessler, Thomas M. Laronge, and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 8 p Repr. from J. of Chem. Phys., v. 51, no. 8, 15 Oct. 1969 p 3213 - 3219 refs (See N71-12313 03-04)
(A70-14003) Avail: NTIS CSCL 06A

By studying the optical rotatory power (OR) of a compensated cholesteric helical structure, it is possible to observe both thermally induced helical inversion and electric field perturbations of the helix. For a cholesteryl chloride – cholesteryl myristate 1.75:1 mixture, the OR changes sign at T = T(nematic) – 42 deg increasing to infinity prior to the inversion. Upon application of a dc electric field parallel to the helix axis, the OR decreases continuously and reversibly by a factor of 4 in the field range 0.25 F sub u <F <F sub u, where F sub u denotes the critical field required to induce a nematic transition. This effect cannot be explained as a macroscopic reordering of the material, but is rather due to a decrease in pitch accompanying a conical helical perturbation. This perturbation arises from bending forces tending to align the dipole moments of cholesteryl chloride in the field direction. When a dc field is applied perpendicular to the helix axis, the pitch diverges logarithmically to infinity as F approaches the critical value for inducing a transition.
Author

N71-12319*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
ALTERNATING-CURRENT-FIELD INDUCED CHOLESTERIC-NEMATIC PHASE TRANSITIONS
H. Baessler and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 4 p Repr. from J. of Chem. Phys., v. 51, no. 12, 15 Dec. 1969 p 5397–5400 refs (See N71-12313 03-04)
(A70-20053) Avail: NTIS CSCL 06A

In order to determine whether interaction between the permanent or the induced molecular dipole moments of a cholesteric liquid crystal and an applied electric field is responsible for inducing a transition to a nematic phase, ac-field measurements were performed. In a mixture of cholesteryl chloride and cholesteryl myristate, phase transitions can be induced by an ac field of a frequency up to a threshold value which is approximately equal to the relaxation frequency for rotation of cholesteryl chloride molecules around a short molecular axis which has recently been determined by dielectric measurements. A relation between the rms field and the threshold value is derived and experimentally verified. The absence of ferroelectric ordering in the induced and aligned nematic phase is demonstrated.
Author

N71-12320*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
DIPOLE RELAXATION IN A LIQUID CRYSTAL
H. Baessler, R. R. Beard, and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 7 p Repr. from J. of Chem. Phys., v. 52, no. 5, 1 Mar. 1970 refs (See N71-12313 03-04)
(A70-26859) Avail: NTIS CSCL 06A

The real and imaginary parts of the dielectric constant of a 1.75:1.00 mixture of cholesteryl chloride and cholesteryl myristate were measured in the frequency range 1 kHz to 10 MHz. Two modes of molecular rotation are found to contribute to dipole relaxation: rotation of cholesteryl chloride around a short molecular axis (process R sub 1), and rotation of cholesteryl myristate around a long molecular axis (R sub 2). The relaxation frequency associated with R sub 1 changes by not more than a factor of 2 when going from the cholesteric phase to the isotropic melt or to a field-induced aligned nematic phase. This indicates that the potential barrier hindering molecular rotation is determined by short-range order rather than long-range order. From the magnitude of the dielectric increment, conclusions are drawn regarding the molecular arrangement in the various phases. The temperature dependence of the relaxation frequency is analyzed in terms of absolute rate theory.
Author

N71-12321*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
MAGNETIC-FIELD EFFECTS ON A COMPENSATED CHOLESTERIC LIQUID CRYSTAL
Thomas H. Laronge, H. Baessler, and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 3 p Repr. from J. of Chem. Phys., v. 51, no. 10, 15 Nov. 1969 p 4186–4188 refs (See N71-12313 03-04)
(A70-17326) Avail: NTIS CSCL 06A

By measuring changes in the dielectric constant of a 1.75:1 cholesteryl chloride–cholesteryl myristate (CM) mixture in the presence of magnetic fields H up to 10 kG, the orientation of the molecular and helical axes with respect to the field direction can be deduced, and the possibility of a dependence of the alignment process on the pitch Z of the helix is explored. A comparison is also made of the effects of electric and magnetic fields on CM; an electric field of 500 V/cm counteracts a magnetic field of the order of 10 kG. The anisotropy of the diamagnetic susceptibility is deduced to be approximately 10 to the 9th power.
Author

N71-12322*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry and Biological Sciences.
THE ABSENCE OF HELICAL INVERSION IN SINGLE COMPONENT CHOLESTERIC LIQUID CRYSTALS
H. Baessler, P. A. G. Malya, W. R. Nes, and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 10 p Repr. from Mol. Cryst. and Liquid Cryst. (Engl.), v. 6, 1970 p 329–338 refs (See N71-12313 03-04)
(Grant NIH AM-12172)
Copyright. Avail: NTIS CSCL 06A

Since a thermally induced helical inversion has been observed in cholesteryl 2-(2 ethoxyethoxy) ethyl carbonate (CEC), it has been the view that compensation of the helical structure of cholesteric liquid crystals does not require the presence of two compounds which separately form a right and a left handed helix. The present investigation demonstrates that the material used in the previous investigation was probably a compensated mixture because it contained an impurity in a rather high concentration. Pure CEC forms a right handed helix with a pitch of 6000 A at room temperature, and with no indication of a thermally induced helical inversion. It is further shown that in general the sense of the helical screw is not necessarily identical with the sign of the optical rotation of the constituent molecules.
Author

N71-12323*# Drexel Univ., Philadelphia, Pa. Dept. of Chemistry.
HELICAL TWISTING POWER OF STEROIDAL SOLUTES IN CHOLESTERIC MESOPHASES
H. Baessler and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 7 p Repr. from J. of Chem. Phys., v. 52, no. 2, 15 Jan. 1970 p 631–637 refs (See N71-12313 03-04)
(A70-21524) Avail: NTIS CSCL 06A

Shifts in the nematic temperature of a compensated cholesteric liquid-crystal solvent, consisting of cholesteryl chloride and cholesteryl myristate, are caused by adding steroidal solutes. A helical twisting power P can be defined which is a molecular property; there is a linear dependence of the inverse of the solute concentration on the helical pitch. The method has the advantages of (1) allowing study of compounds which do not form mesophases themselves and (2) eliminating temperature effects. For a series of fatty acid esters of cholesterol, P decreases with decreasing number of carbon atoms in the ester chain, and shows a zigzag fine structure with P having higher values for odd-numbered carbon-atom chains. P, and therefore the helix, changes rotational senses if the ester chain is replaced by Cl, Br, or OH. Changes are also discussed associated with modification of the 17 side chain or the steroid ring system itself. A model is proposed attributing P to the molecular asymmetry at the 3 beta position of the steroid ring, which can cause macroscopic twist if two lever arms are present, one of which lacks rotational symmetry.
Author

N71-12324*# Drexel Univ., Pittsburgh, Pa. Dept. of Chemistry.
DETERMINATION OF THE PITCH OF A CHOLESTERIC LIQUID CRYSTAL BY INFRARED TRANSMISSION MEASUREMENTS
H. Baessler and M. M. Labes *In its* Mech. for the Effect of Elec. and Magnetic Fields on Biol. Systems Sep. 1970 3 p Repr.

from Mol. Cryst. and Liquid Cryst. (Engl.) v. 6, 1970 p 419-422 refs (See N71-12313 03-04)
Copyright. Avail: NTIS CSCL 06A

A simple method is presented for determining the pitch based on transmission measurements. It can be particularly valuable in the infrared, i.e. a pitch range of about 0.5 to 5 microns where reflectance measurements are difficult. Author

N71-12325*# Techtran Corp., Glen Burnie, Md.
CONSUMPTION OF O2 IN AN ISOLATED RAT INTESTINE DEPRIVED OF ADRENALS [IL CONSUMO DI O2 DELL'INTESTINO ISOLATO DI RATTO SURRENOPRIVO]
P. Pietra et al Washington NASA Dec. 1970 2 p Transl. into ENGLISH from Boll. Soc. Ital. Biol. Sper. (Italy), v. 44, 1968 p 152
(Contract NASw-2037)
(NASA-TT-F-13418) Avail: NTIS CSCL 06A

The results of adrenalectomy indicate increased oxygen consumption of rat intestines. Oxygen consumption is compared to body weight. Author

N71-12326*# California Univ., Berkeley. Dept. of Nutritional Sciences.
INVESTIGATION OF THE NUTRITIONAL PROPERTIES OF HYDROGENOMONAS EUTROPHA Final Report, 1 Nov. 1964 31 Dec. 1968
Doris Howes Calloway and Sheldon Margen 31 Dec. 1968 80 p refs
(Grant NGR-05-003-089)
(NASA-CR-111599) Avail: NTIS CSCL 06M

The nutritional properties and compositions of several lots of Hydrogenomonas eutropha cells were made under various conditions. Among the findings are the following: The protein is adequately digested. The absorbed protein is of good quality. Stored lipid is not digestible. For humans the amount of dietary preformed nucleic acids should be less than 8 g/day in a diet providing 75 g of protein. Bacteria might possibly serve as a sole source of protein for man. The maximum amount of bacteria included in the human diet is much less than 6 g. Papers are appended on protein quality and nutritional value of lipids in H. eutropha; uric acid production in man from dietary bacteria and the suppression of the uric acid; and human intolerance to bacteria. For individual titles, see N71-12327 through N71-12332. N.E.N.

N71-12327*# California Univ., Berkeley. Dept. of Nutrional Sciences.
PROTEIN QUALITY OF THE BACTERIUM HYDROGENOMONAS EUTROPHA
Doris Howes Calloway and Adarsh M. Kumar *In its* Invest. of the Nutritional Properties of Hydrogenomonas Eutropha 31 Dec. 1968 3 p refs Repr. from Appl. Microbiol., v. 17, no. 1, Jan. 1969 p 176-178 (See N71-12326 03-04)
(A69-23306) Copyright. Avail: NTIS CSCL 06M

Hydrogenomonas eutropha cells harvested from semicontinuous autotrophic culture and washed free of substrate contain about 13% of nitrogen on a dry-solids basis. Biological value and digestibility of the bacterial nitrogen were determined in the rat by use of an abbreviated Mitchell-Thomas nitrogen balance technique and casein as the standard protein. Casein nitrogen was 99% digestible, and that of both whole boiled and sonically ruptured bacterial cells was 93%. Biological value of casein and the bacterial preparations was uniformly 77%. Amino acid composition of the bacteria, as in the case of casein, indicates a first limitation of sulfur-containing amino acids. These compositional features suggest that H. eutropha may be potentially valuable as a protein supplement in animal feeds. Author

N71-12328*# California Univ., Berkeley. Dept. of Nutritional Sciences.
NUTRITIONAL VALUE OF LIPIDS IN HYDROGENOMONAS EUTROPHA AS MEASURED IN THE RAT
Carol I. Waslien and Doris Howes Calloway *In its* Invest. of the Nutritional Properties of Hydrogenomonas Eutropha 31 Dec. 1968 18 p refs Submitted for publication (See N71-12326 03-04)
Avail: NTIS CSCL 06M

Hydrogenomonas eutropha is known to accumulate lipid, comprised largely of polymerized beta hydroxybutyric acid, when maintained in nitrogen-deficient medium. This lipid was very poorly absorbed from bacterial diets by mice, even though nitrogen absorption was adequate. The monomer, free beta hydroxybutyric acid, was well absorbed from purified diet. Rats fed the monomer or butyric acid ate less food and grew more slowly than rats fed corn oil. Author

N71-12329*# California Univ., Berkeley. Dept. of Nutritional Sciences.
URIC ACID PRODUCTION OF MEN FED GRADED AMOUNTS OF EGG PROTEIN AND YEAST NUCLEIC ACID
Carol I. Waslien, Doris Howes Calloway, and Sheldon Margen *In its* Invest. of the Nutritional Properties of Hydrogenomonas Eutropha 31 Dec. 1968 6 p refs Repr. from Am. J. Clin. Nutr., v. 21, no. 9, ep. 1968 p 892-897 Pr en, d at the 52p Ann. Meeting of the Federation of Im. Soc. for Exptl. Biol., Atlantic City, Apr. 1968 (See N71-12326 03-04)
(Grants NGR-05-003-068; NIH AM-10202)
(A69-15968) Avail: NTIS CSCL 06A

Healthy male subjects were fed purine-free basal diets containing 0-75 g of protein and, at the highest protein level, 0-8 g of added yeast ribonucleic acid in order to differentiate effects of these dietary components on plasma and urinary uric acid production. Urinary uric acid levels were significantly higher and plasma levels lower with 75 g of protein than with a protein-free diet. When nucleic acid was fed, plasma and urinary uric acid increased linearly in four of five subjects. Predictive equations were derived describing this response to dietary nucleic acid. Author

N71-12330*# California Univ., Berkeley. Dept. of Nutritional Sciences.
URIC ACID LEVELS IN MEN FED ALGAE AND YEAST AS PROTEIN SOURCES
Carol I. Waslien, Doris Howes Calloway, Sheldon Margen, and Francoise Costa *In its* Invest. of the Nutritional Properties of Hydrogenomonas Eutropha 31 Dec. 1968 80 p refs (See N71-12326 03-04)
Avail: NTIS CSCL 06A

Microorganisms grown on human or industrial waste may be economical, nutritious food sources. Algae (Chlorella sorokiniana) and yeast (Torulopsis utilis) were compared with casein at two nitrogen levels as sole sources of protein for men. Biological value of algal protein was superior to casein, but yeast protein was not quite as good as algae, in diets containing 25 g protein. When 50 g of algae protein was consumed, true nitrogen digestibility was reduced, but nitrogen balances indicated that 50 g of any of these proteins met or exceeded dietary requirements. Urinary uric acid increased considerably with algae and yeast. Renal clearances were not sufficient to prevent abnormally high plasma uric acid levels, comparable to those found in gout. Author

N71-12331*# California Univ., Berkeley. Dept. of Nutritional Sciences.
SUPPRESSION OF URIC ACID FORMATION FROM DIETARY NUCLEIC ACID WITH ALLOPURINOL
Jean Bowering, Sheldon Margen, Doris Howes Calloway, and April Rhyne *In its* Invest. of the Nutritional Properties of Hydrogenomonas Eutropha 31 Dec. 1968 9 p refs Submitted for publication (See N71-12326 03-04)
Avail: NTIS CSCL 06A

In a controlled human metabolic study, addition of 8 g/day of yeast RNA to a low-protein, purine-free formula diet produced elevated serum and urinary uric acid levels which could be reduced

by allopurinol, an inhibitor of uric acid formation. Administration of 100 mg/day of allopurinol also led to a rise in urinary hypoxanthine plus xanthine which was less than the fall in urinary uric acid. Since total oxypurine excretion was reduced, it appears that allopurinol effectively suppresses both endogenous purine synthesis and synthesis of uric acid from exogenous purines. Author

N71-12332*# California Univ., Berkeley. Dept. of Nutritional Sciences.
HUMAN INTOLERANCE TO BACTERIA AS FOOD
Carol I. Weslien, Doris Howes Calloway, and Sheldon Margen *In its* Invest. of the Nutritional Properties of Hydrogenomonas Eutropha 31 Dec. 1968 4 p refs Repr. from Nature (London), v. 221, no. 5175, 4 Jan. 1969 p 84–85 Sponsored in part by NIH
(See N71-12326 03-04)
(A69-27265) Avail: NTIS CSCL 06M

Lots of Hydrogenomonas eutropha, washed free of the culture medium, were prepared as food and fed to males. Severe symptoms were produced by autotrophically grown H. eutropha; less severe symptoms were produced by heterotrophically grown H. eutropha. A lot of Aerobacter aerogenes was also fed to the subjects and produced basically the same as the first lot of H. eutropha. Blood pressure and body temperature were not affected. N.E.N.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N71-12333*# General Dynamics/Convair, San Diego, Calif.
A CARBON DIOXIDE REDUCTION UNIT USING BOSCH REACTION AND EXPENDABLE CATALYST CARTRIDGES
R. F. Holmes, E. E. Keller, and C. D. King Washington NASA Nov. 1970 67 p refs
(Contract NAS1-8217)
(NASA-CR-1682; GDC-DBD70-001) Avail: NTIS CSCL 06K

The feasibility of producing an efficient and reliable flight-qualified carbon dioxide reduction unit for use in life support systems for long-duration and space missions has been demonstrated. A prototype reduction unit utilizing the Bosch catalytic reaction and expendable catalyst cartridges was developed. The unit has two reactors with replaceable catalyst cartridges, each reactor having process capacity for continuous reduction of the carbon dioxide which would be produced metabolically by a four-man crew. Reaction was easily alternated between the two reactors allowing cartridge replacement without process interruption. Reaction within the catalyst cartridge was readily initiated and maintained. No carbon migrated from the cartridge or was formed by reactions outside of the cartridge. Cartridge life was approximately three days and replacement was a simple and clean operation. Author

N71-12334*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FIXED-BASE VISUAL-SIMULATION STUDY OF MANUALLY CONTROLLED OPERATION OF A LUNAR FLYING VEHICLE
G. Kimball Miller, Jr. and Gene W. Sparrow Washington Dec. 1970 42 p refs
(NASA-TN-D-5983; L-7320) Avail: NTIS CSCL 05H

A fixed-base visual-simulation study has been conducted to determine the instrumentation and control requirements for operating a lunar flying vehicle over a range of about 2.25 nautical miles (4.167 km). The study indicated that a rate-command attitude control system was required for small center-of-gravity offsets. The average characteristic velocity required to fly a 500-foot-altitude (152.4-m)-flat-top trajectory to the target was 1197.6 ft/sec (365.0 m/sec) with a standard deviation of 199.0 ft/sec (60.6 m/sec) when the instrumentation used included a three-axis gyro-horizon, a fuel indicator, a lunar thrust-weight-ratio indicator, and an altimeter. When horizontal- and vertical-velocity indicators were included, the average characteristic velocity was reduced by approximately 150 ft/sec (45.7 m/sec) and the standard deviation by 100 ft/sec (30.5 m/sec). It was extremely difficult to perform the maneuver without velocity indicators or an altimeter. Author

N71-12335* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PRESSURE SUIT TIE-DOWN MECHANISM Patent
James H. O'Kane, inventor (to NASA) Issued 22 Nov. 1966 (Filed 7 Apr. 1964) 11 p Cl. 2-2.1
(NASA-Case-XMS-00784; US-Patent-3,286,274; US-Patent-Appl-SN-358127) Avail: US Patent Office CSCL 06Q

A helmet and torso tiedown mechanism for pressure suits is described. The mechanism is positioned in the front of the suit and attached to it by cables fastened to opposite sides of a rigid neck ring of the suit on which the helmet is secured, or they may be attached to opposite sides of the helmet itself. The mechanism is also secured by flexible cords to one end of a crotch belt which is secured at its other end to the suit in the vicinity of the crotch or is passed under the crotch and attached to the back of the suit. The mechanism includes a pulley block assembly on which are mounted a pair of rollers or pulleys for supporting a pair of the cords, each of which is reeved over one of the pulleys and attached at its ends to the crotch belt. To shorten the suit, the two movable cords are grasped with both hands and pulled in the directions opposed to their directions of free movement to spread the cords in front of the chest. The cord pair is also provided with an elastic section which maintains the cord taut while permitting variation in its length. R.B.

N71-12336* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
HAND-HELD SELF-MANEUVERING UNIT Patent
Harold I. Johnson and William C. Huber, inventors (to NASA) Issued 6 Sep. 1966 (Filed 3 Dec. 1965) 8 p Cl. 244-4
(NASA-Case-XMS-05304; US-Patent-3,270,986; US-Patent-Appl-SN-511567) Avail: US Patent Office CSCL 05H

A hand-held maneuvering unit is described which is capable of propulsion and attitude control of an astronaut in a zero or reduced gravity environment. The device consists of a propulsion unit utilizing the thrust developed by a pressurized gas escaping from various nozzles. The thrust is initiated by a rocking trigger mechanism designed to provide either forward or reverse movement of the operator. The fuel supply may be affixed to and carried by the trigger housing in a pair of tanks, or it may be carried in tanks removed from the unit. The unit contains compensated type poppet valves which are opened by trigger deflection and enable fuel flow proportionate to the magnitude of deflection. R.B.

N71-12337# AAI Corp., Baltimore, Md.
ACCURATE AERIAL DELIVERY SYSTEM, PHASE 1 Summary Report
Walter L. Black, B. W. Jezek, J. S. Taylor, R. D. Mikesell, and E. A. Thomassen Sep. 1969 181 p refs
(Contract DOT-CG-93227-A)
(AD-712288; ER-5934) Avail: NTIS CSCL 6/7

The Coast Guard, as a part of their sea rescue mission, are frequently required to aid distressed boats by dropping from an airplane a package containing emergency pumping equipment. The boats usually are unable to maneuver, making it necessary to accomplish the drop in the near vicinity of the boat so that the

package can be captured from the deck of the boat. Due to the precision required, plus the usual situation of unsettled weather conditions, delivery failures are common. A study was performed of delivery concepts, equipment, and techniques to determine if equipment and procedural changes could be devised that would significantly improve delivery success. Author (TAB)

N71-12338# AAI Corp., Baltimore, Md.
ACCURATE AERIAL DELIVERY SYSTEM, PHASE 2 Summary Report
Walter L. Black Nov. 1969 72 p
(Contract DOT-CG-93227-A)
(AD-712289; ER-6020) Avail: NTIS CSCL 6/7

The Coast Guard, as part of their sea rescue mission, are frequently required to aid distressed boats by dropping from an airplane a package containing emergency pumping equipment. Due to the precision required, plus the usual situation of unsettled weather conditions, delivery failures are fairly common. A study was performed of delivery concepts, equipment, and techniques to determine if equipment and procedural changes could be devised that would significantly improve delivery success. The report describes the equipment and delivery techniques that are recommended for this delivery system. Author (TAB)

N71-12339# Naval Postgraduate School, Monterey, Calif.
A SURVEY OF ALLOCATION MODELS IN SEARCH THEORY
Brian David Engler (M.S. Thesis) Sep. 1970 29 p refs
(AD-712836) Avail: NTIS CSCL 15/7

The problem of optimally allocating available effort to search for an object at sea comprises a major class of problems in naval warfare. This thesis presents in some detail Koopmans classic two-region and continuous search models, along with the n-region discrete model which provides some continuity between the two. Brief summaries of four of the more important extensions to the basic theory are also included. Author (TAB)

N71-12340# Army Natick Labs., Mass. Clothing and Personal Life Support Equipment Lab.
FLOW OF HEAT AND WATER VAPOR THROUGH PROTECTIVE CLOTHING
Ferdinand Votta, Jr. and Leo A. Spano Aug. 1970 23 p
(AD-712994; C/PLSEL-78; TR-71-5-CE) Avail: NTIS CSCL 6/7

In a continuing effort to improve the comfort and working efficiency of persons wearing various protective clothing systems, a sweating cylinder to test the heat and water vapor transfer characteristics of such systems was designed, constructed and tested. With this equipment, the heat and water vapor transfer through a carbon-treated polyurethane-nylon tricot laminated clothing system was determined under a wide range of simulated environmental conditions. Author (TAB)

N71-12341* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HARNESS ASSEMBLY Patent
Dan H. Dane, inventor (to NASA) Issued 23 Jun. 1970 (Filed 23 Apr. 1968) 11 p Cl. 297-385; Int. Cl. A62b35/00; Int. Cl. C09b
(NASA-Case-MFS-14671; US-Patent-3,516,711;
US-Patent-Appl-SN-723476) Avail: US Patent Office CSCL 06Q

A harness assembly adapted to support a human test subject on a ground based apparatus simulating low or no gravity conditions is described. The assembly has a backrest adjustably connected to the support bar of the simulator so as to position the center of gravity of the subject in the harness at the desired location. On each side of the frame a main side member is pivotally connected to the side of the frame approximating the hip joint. Pivotally joined to the lower end is a lower side member which is adapted to be strapped to a thigh, and pivotally attached to this joint, which approximates the knee, is a member to be strapped to a lower leg. Weights are attached to the upper end of each main side member to counterbalance the weight of the legs. The human test subject can pivot his legs, and the effects of weightlessness on the legs are simulated. F.O.S.

N71-12342* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TELEMETER ADAPTABLE FOR IMPLANTING IN AN ANIMAL Patent
Thomas B. Fryer, inventor (to NASA) Issued 1 Jul. 1969 (Filed 4 Nov. 1966) 10 p Cl. 325-143; Int. Cl. H04b1/04; Int. Cl. G01k5/18, 5/52
(NASA-Case-XAC-05706; US-Patent-3,453,546;
US-Patent-Appl-SN-592694) Avail: US Patent Office CSCL 06B

A telemeter is described which generates two voltages for biomedical instrumentation. The voltage ratios are proportional to the condition monitored. Voltages are alternately sampled, and equal-duration bursts of RF energy are transmitted. The intervals between bursts are alternately T sub 1 and T sub 2. The ratio of T sub 1 to T sub 2 is equal to the ratio of the two voltages. Power supply fluctuation and other errors are cancelled as a result of the proportional voltage ratios. E.C.

N71-12343* Weber Aircraft Corp., Burbank, Calif.
ARTICULATED MULTIPLE COUCH ASSEMBLY Patent
Leon P. Stone and David L. Johansen, inventors (to NASA) Issued 9 Sep. 1969 (Filed 5 Jan. 1968) 16 p Cl. 297-68; Int. Cl. A47c1/022, 1/031, 15/00 Sponsored by NASA
(NASA-Case-MSC-11253; US-Patent-3,466,085;
US-Patent-Appl-SN-695973) Avail: US Patent Office CSCL 06Q

A multiple couch assembly is described which is applicable for astronauts and comprises side-by-side articulated couch frames, individually detachably mounted on a main supporting frame structure. The frames contain pivotally connected torso, thigh, and lower leg support sections. A releasable latch mechanism is provided to releasably secure the thigh support at angles relative to the torso support. The thigh support section is also pivotal to positions parallel to the torso section so that the couch frame is either in a compact bundle for stowage or is adapted to provide a seat. Guide track and roller means give the couch frames a degree of longitudinal movement. Fabric webbing supports body attitude and contour under excessive G forces. E.C.

N71-12344* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PRESSURE GARMENTJOINT Patent
Michael A. Marroni, Douglas E. Getchell, and John J. Korabowski, inventors (to NASA) Issued 3 Feb. 1970 (Filed 7 Oct. 1966) 5 p Cl. 2-2.1; Int. Cl. B63c11/04
(NASA-Case-XMS-09636; US-Patent-3,492,672;
US-Patent-Appl-SN-586330) Avail: US Patent Office CSCL 06Q

A flexible, universal joint for pressurized space suits is described. The device provides an omnidirectional joint with the following characteristics: (1) easily moved and stable in any position, (2) completely soft in the unpressurized condition, and (3) capable of retaining pressurized condition within the space suit. Ferrules and guides are provided for the passage of cables through the joint. P.N.F.

N71-12345* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EMERGENCY ESCAPE SYSTEM Patent
Jack A. Kinzler and David L. McCraw, inventors (to NASA) Issued 20 Jan. 1970 (Filed 3 Apr. 1969) 6 p Cl. 29-400; Int. Cl. B23p17/00, 1904
(NASA-Case-MSC-12086-1; US-Patent-3,490,130;
US-Patent-Appl-SN-812999) Avail: US Patent Office CSCL 06G

A system for providing emergency, man-sized passageways in the walls of an enclosure is described. The device provides a

means of instantaneously cutting openings through the wall of enclosure so as to permit the immediate exit of personnel in the event of an emergency. A die member containing a draw bar assembly is attached to a pivotal support member located on the exterior surface of the enclosure. Interior and exterior controls are provided to energize a power source which actuates the draw bar and cuts out a man-sized section of the wall to provide an emergency exit or ingress. P.N.F.

N71-12346* Institute of Research and Instrumentation, Houston, Tex.

PRESSED DISC TYPE SENSING ELECTRODES WITH ION-SCREENING MEANS Patent

Benjamin Mosier and Joe L. Day, inventors (to NASA) Issued 20 Jan. 1970 (Filed 5 Jan. 1967) 5 p Cl. 128-2.1; Int. Cl. A61b5/05; Int. Cl. H01b1/02 Sponsored by NASA
(NASA-Case-XMS-04212-1; US-Patent-3,490,440; US-Patent-Appl-SN-607461) Avail: US Patent Office CSCL 09E

An improved pressed electrode for biopotential applications is discussed. The electrode is formed of intimately commingled powders of relatively small size in which silver, silver halogen salt, and a colloidal material comprising an ion screening means are pressed to form the electrical contact. The electrode permits passage of the biopotential signal with minimum noise from the electrode and reduces the effects of chemical poisoning produced by perspiration from the skin of the subject. P.N.F.

N71-12347# Massachusetts Univ., Amherst. School of Engineering.

THE LIFE SUPPORT SYSTEM FOR THE SEA-BED OBSERVATION LABORATORY

David B. Wyman (M.S. Thesis) Jul. 1970 79 p refs
(Contract N00014-68-A-0146-0006; Proj. Themis)
(AD-712823; THEMIS-UM-70-4) Avail: NTIS CSCL 6/11

The investigation covers the systems engineering involved with the selection of an optimum life support system for the Sea-Bed Observation Laboratory. The life support system must supply breathing gases, maintain the temperature and humidity within the comfort zone, provide instrumentation for monitoring the atmosphere, and provide an emergency breathing system. The factors of weight, volume, power, safety, reliability and life cycle cost have all been considered in the selection of the optimum components for the life support system. Author (TAB)

N71-12348# Southwest Research Inst., San Antonio, Tex.

AUTOMATIC FIRE PROTECTION SYSTEM FOR MANNED HYPERBARIC CHAMBERS. PHASE 1: SYSTEM DEVELOPMENT Final Report, 13 Jun. 1968 – 1 Aug. 1970

Lester A. Eggleston, William R. Herrera, and George E. Commerford 1 Aug. 1970 137 p refs
(Contract N62399-68-C-0022; SwRI Proj. 03-2383)
(AD-712848; NCEL-CR-70-003) Avail: NTIS CSCL 13/12

The problems of fire detection and suppression in dense atmospheres typical of diving chamber service are analyzed, with special attention to nitrogen-oxygen up to 8 atm and helium-oxygen up to 45 atm. Spectral comparisons indicate either infrared or ultraviolet flame detectors may be used. The current IR equipment is the better choice. There is a need for a combustion products detector and an acceptable model is available. Although it is sensitive to changes in atmospheric density, automatic compensation is feasible. Dense atmospheres affect the performance of water spray nozzles. Complete data are given for a typical line of commercial nozzles for four sizes and five nozzle angles, at flow pressures of 60 psig and chamber pressures up to 500 psig. A water rate for suppression is estimated at 2-3 gpm/sq ft, and supported by fire test data. The flash-off of dissolved gases can be a serious problem in system design. A closed water loop balanced to chamber pressure and pump driven when needed is preferred to any system which exposes water to gas pressures above the chamber operating level for periods long enough to permit saturation. Author (TAB)

N71-12349# Atomic Energy Commission Research Establishment, Riso (Denmark).

SIMULATION OF RECOGNITION LAYER NETS BY MEANS OF THE DIGITAL COMPUTER PDP-8

R. Dulewicz Feb. 1970 29 p
(PB-192138; RISO-M-1232; R-1-70) Avail: NTIS CSCL 06D

In the preliminary stages of the work concerning a technical implementation of the simulation of recognition layer nets by means of the digital computer PDP-8, a method of detecting information points was developed. The method was used in an attempt to recognize not only the information points, but complete letters. It should be emphasized that the work was not intended to develop a universal recognition system, but to prove the practical possibility of detecting the information points by a simple method based on the application of layer nets organized according to the rule of lateral influences. Such two-layer networks capable of detecting the characteristic features of pictures were simulated by means of the digital computer PDP-8. Author (USGRDR)

N71-12350# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.

PERFORMANCE RATINGS AND PERSONALITY FACTORS IN RADAR CONTROLLERS

Samuel Karson and Jerry W. O'Dell Sep. 1970 4 p refs Presented at 1969 Ann. Meetings of the Aerospace Med. Assoc., San Francisco
(AM-70-14) Avail: NTIS

The problem of whether primary or second-order personality questionnaire factors were related to job performance ratings on the Employee Appraisal Record of 264 controllers was investigated. A Pearson correlation matrix was computed based on 19 variables which included EAR parts 2 and 4, a motivational distortion score, and the primary factors measured by the Sixteen Personality Factor Questionnaire. A principal axis factor analysis was completed with varimax rotation which yielded eight second-order factors which were identified as follows: anxiety versus dynamic integration, subduedness versus independence, criterion, cortertia versus pathemia, exvia versus invia, intelligence, obsessive-compulsive, and rebelliousness. While all of these second-order factors were identified previously, the criterion variables were not related to any of the personality measures. A discussion of the results led to the conclusion that the criterion problem needs to be solved before progress can be expected. Author

N71-12351* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BACKPACK CARRIER Patent

Amos A. Spady, Jr. and Frank G. Read, inventors (to NASA) Issued 3 Feb. 1970 (Filed 10 Oct. 1967) 8 p Cl. 224-25; Int. Cl. A45d3/10; Int. Cl. A47d13/02
(NASA-Case-LAR-10056; US-Patent-3,493,153; US-Patent-Appl-SN-674357) Avail: US Patent Office CSCL 06Q

A backpack carrier is described, suitable for use by lunar explorers, with retractable support legs which allows the user to don the carrier without bending, or lifting. A clearance cavity provides the capability for its being donned over an in-place load, and it is convertible to a wheeled rescue vehicle. F.O.S.

N71-12352# General Electric Co., Philadelphia, Pa. Missile and Space Div.

CLOSED CYCLE RESPIRATOR DEVELOPMENT PROGRAM Final Report

25 Sep. 1970 6 p refs
(Contract N00014-69-C-0329)
(AD-712560; RDP-021) Avail: NTIS CSCL 6/11

The original objective of the Closed Cycle Respirator Development Program was to produce four portable volume controlled prototype respirators. Subsequently, the program was expanded to include the design and construction of a test device to analytically evaluate the performance characteristics of the

prototype respirators. This device was appropriately referred to as the lung simulator. Four prototype units were delivered to the National Naval Medical Center (NNMC). Operating manuals covering the operation and maintenance procedures for the prototype respirators and the lung simuator were delivered respectively with the equipment. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N71-12353# Hamburg Univ. (West Germany). Inst. fuer Pharmazeutische Chemie.

ANALYSIS OF HYDROPHILIC COMPONENTS IN ESTER EMULSIFIERS AND DETERMINATION OF THE COLLOIDAL MOLECULAR WEIGHT OF TENSIDES USING GEL CHROMATOGRAPHY [DER NACHWEIS HYDROPHILER KOMPONENTEN IN ESTEREMULGATOREN UND DIE BESTIMMUNG DES MIZELLMOLEKULARGEWICHTS VON TENSIDEN MIT DER GELCHROMATOGRAPHIE]

Peter Schmidt (Ph.D. Thesis) 1970 182 p refs In GERMAN
Avail: NTIS

The hydrophilic components of non-ionogenic ester emulsifiers were analyzed on the basis of polyols. In order to identify the central molecule it was necessary to split the ethylene oxide chains and to analyze the derivatives of the polyol body. Procedures for several ester emulsifiers were established. The molecular weights of tenside colloids were determined by gel chromatography. Author (ESRO)

N71-12354# Hamburg Univ. (West Germany). Inst. fuer Organische Chemie.

ELECTRON IMPACT INDUCED REACTIONS OF OPEN-CHAINED AND MONOCYCLIC POLYMETHOXYALKANES [ELEKTRONENSTROSS-INDUZIERTE REAKTIONEN OFFENKETTIGER UND MONOCYCLISCHER POLYMETHOXYALKANE]

Johann Winkler (Ph.D. Thesis) 1970 126 p refs In GERMAN
Avail: NTIS

Molecular structure changes in open-chained and monocyclic polymethoxyalkanes induced by electron impact ionization were investigated in a mass spectrometer and revealed migration of methoxy groups. Using cyclohexanes labelled with deuterium, it was shown that fragmentation begins with the migration of an H-atom from a carbinol-C atom to the ionized oxygen atom of a methoxy group. Definite assignments of methoxy and hydroxy constituents were made from the mass spectra. Author (ESRO)

N71-12355# Hamburg Univ. (West Germany). Inst. fuer Organische Chemie und Biochemie.

VIBRATION SPECTROSCOPIC STRUCTURE INVESTIGATION OF THIOAMIDES [SCHWINGUNGSSPEKTROSKOPISCHE STRUKTURUNTERSUCHUNGEN AN THIOAMIDEN]

Hans Peter Kubersky (Ph.D. Thesis) 1970 239 p refs In GERMAN
Avail: NTIS

In order to understand chemical properties of thioamides a spectroscopic analysis is carried out. The molecular structure and tautomery are investigated with vibrational spectra obtained from infrared and Raman spectroscopy. ESRO

N71-12356# Princeton Univ., N.J.

ELECTRONIC EFFECTS OF CHEMISORPTION ON A POWDERED ZINC OXIDE CATALYST Technical Report, Sep. 1968 – Sep. 1970

Victor M. Chong (Ph.D. Thesis) and Peter Mark Sep. 1970 110 p refs
(Contract N00014-67-A-0151-0014)
(AD-712856; ONR-TR-8) Avail: NTIS CSCL 7/4

The report presents a general discussion of electronic surface states and their possible electronic and catalytic effects. It also presents a method by which the temperature-dependence of the catalysts conductivity can be used to elicit information on the disposition of the surface states relative to the bulk band structure. The catalyst was ZnO in powder form and an impedance technique was used to measure its conductivity under single gas (CO and O2) and differential reaction (2CO + O2 yields 2CO2) ambients. Oxygen acceptor surface states appear to have a dominant influence over the catalysts conductivity even at O2 pressures as low as 0.00001 torr and in reaction mixture containing greater than 4 parts CO to one part O2. The apparent donor effect of adsorbed CO appears to result from the interaction with adsorbed or lattice oxygen rather than from the formation of a donor-like CO adsorption state. The experimental measurements tend to confirm the energy band structure model of this semiconductor catalyst and reveal certain features of interest for the electronic theory of catalysis. However, it does appear that powder systems may be too complex to deal with quantitatively at the present stage of development of electronic surface state theories. Author (TAB)

N71-12357# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.

POLYPHENYL-AS-TRIAZINES

M. Hergenrother and D. E. Kiyohara Aug. 1970 21 p refs Presented at 160th Natl. Meeting of the Am. Chem. Soc., Chicago, Sep. 1970 Submitted for publication
(AD-712407; D-1-82-0888) Avail: NTIS CSCL 11/9

The report discusses the synthesis and uses of poly-as-triazines. Poly-as-triazines can be synthesized in high molecular weights while retaining process ability and solubility in certain organic solvents. Consequently they can be processed into potentially useful high temperature adhesives, laminating resins, protective coatings, and films. Preliminaryevaluations have hown considerable promise along these lines. The poly-as-triazines exhibit slightly better thermal stability in air than in an inert atmosphere. This is an usual phenomenon and probably indicates the formation of a more stable material upon initial oxidation. The polyphenyl-as-triazine exhibit excellent stability in air at 500 F as indicated by retention of weight and mechanical properties. Author (TAB)

N71-12358# Iowa State Univ. of Science and Technology, Ames.

CHROMATOGRAPHIC SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF URANIUM

Salim Mohammed Itani (M.S. Thesis) May 1970 32 p refs
(Contract W-7405-eng-82)
(IS-T-385) Avail: NTIS

Uranium(VI) is quantitatively and qualitatively separated from the following ions. Cations: (Li(I), Na(I), K(I), Mg(II), Ca(II), Sr(II), Ba(III), V(IV), Cr(III), Mn(ii), Fe(III), Co(II), Ni(II), Cu(II), Zn(II), Zr(IV), Ag(I), Cd(II), Hg(II), Al(III), Pb(II), Ce(III), Dy(III), Yb(III), Th(IV); Anions: Cl(−), F(−), PO4(−3), SO4(−2), ClO4(−), NO3(−). The extraction of uranium (VI) is done by means of ion exchange column chromatography. The uranium is extracted by the Alamine 336 on Chromosorb W. Uranium (VI) stays on the stationary phase, while the other metal ions are stripped off by elution with 0.05 M sulfuric acid. The rare earth metals are co-extracted with uranium but are removed from the column by careful washing with 0.05 M H2SO4. Uranium is then complexed with Arsenazo I and is stripped off the column. The column is then washed with methyl

alcohol (absolute), and the eluate is collected in a 50-ml volumetric flask. The concentration of uranium is determined spectrophotometrically. Author (NSA)

N71-12359*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT ADVANCES IN EMISSION SPECTROSCOPY AND THE DETERMINATION OF TRACE ELEMENTS IN BIOLOGICAL MATERIALS
William A. Gordon [1970] 13 p refs Presented at Intern. Symp. on the Newer Trace Elem. in Nutr., Grand Forks, N. Dak., 15 - 17 Sep. 1970; sponsored by Dept. of Agric.
(NASA-TM-X-52932) Avail: NTIS CSCL 07D

Detection limits are discussed with respect to the emission spectrometric approach in determination of trace metals in biological materials. Some of the procedures discussed include the argon-silver arc technique and low and high power inductively-coupled microwave discharge techniques. The detection limits for the given techniques are given in tabular form. R.B.

N71-12360# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
THERMOTRANSPORT OF SOLUTES IN LIQUID SILVER
B. N. Bhat and R. A. Swalin 1970 28 p refs Presented at Europhys. Conf. on Atomic Transport in Solids and Liquids, Marstrand, Sweden, 15 - 19 Jun. 1970 Sponsored by AEC
(COO-841-19) Avail: NTIS

A system with the diffusivity of solute element considerably different from that of solvent was investigated. Silver base system was chosen because solute elements in silver are known to diffuse as much as 100% faster than silver itself. Moreover, conventional radioactive tracer technique can be utilized to measure the concentration and hence a more accurate value of the segregation coefficient can be obtained. The results show clearly that the amount of thermotransport of solute in liquid silver varies widely, from almost zero in the case of gold to a large amount in the case of sulfur. Antimony and sulfur segregate to the hot end while gold segregates to the cold end. It is interesting to note that a relation seems to exist between K and (D sub solute - D sub Ag). Author

N71-12361*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GSFC MICRO-VOLATILE CONDENSABLE MATERIALS SYSTEM FOR POLYMER OUTGASSING STUDIES
Aaron Fisher and Benjamin Mermelstein Oct. 1969 36 p refs
(NASA-TM-X-65399; X-735-69-471) Avail: NTIS CSCL 07D

Instruments and techniques used for rapid quantitative screening of gases and condensables evolved from polymeric materials heated in vacuum at 125 C are described. The GSFC volatile-condensable-materials system is adapted from the basic Stanford Research Institute system, with specialized GSFC instrumental and operational modifications. Author

N71-12362# Naval Research Lab., Washington, D.C. Oceanic Chemistry Branch.
THE EFFECTS OF FLUORINE SUBSTITUTION ON THE PROPERTIES AND REACTION RATES OF GLYCIDYL ETHERS Interim Report
James R. Griffith, Scott A. Reines, and Jacques G. O'Rear 19 Aug. 1970 27 p refs
(AD-712507; NRL-7127) Avail: NTIS CSCL 7/3

Two series of fluorine-containing monoglycidyl ethers have been synthesized, and the kinetics of the reaction of these compounds with dibutylamine has been studied by the use of a gas chromatographic method of reaction rate analysis. In tertiary amyl alcohol solution at initial concentrations of 0.200M, all reactions were second order, and the rate constants at 60C were in the range from 5.12 to 0.001114 liters/mole-sec. The effects of fluorine quantity and molecular position on these rate constants are used to support a cyclic-transition-state mechanism for the glycidyl ether-amine reaction. Also, the physical properties of the compounds, including surface tensions, viscosities, densities, and refractive indices, are given Arrhenius parameters for the reactions, including activation energies, frequency factors, and entropies of activation, have also been determined. A series of related fluorine-containing diglycidyl ethers has been synthesized and obtained as high-purity compounds. The physical characteristics of these ethers are given. It is shown that fluorinated diols can be used as reactants with the diglycidyl ethers to produce fluorinated polyols, and some overall concentration-vs-time plots for these reactions are shown. Author (TAB)

N71-12363# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Chemistry and Chemical Engineering.
KINETICS OF AUTOXIDATION OF ATACTIC POLYPROPYLENE IN THE PRESENCE OF COBALT SALTS BY INFRARED SPECTROSCOPY
S. S. Stivala and B. R. Jadrnicek 3 Aug. 1970 28 p refs
(Contract N00014-68-A-0131)
(AD-711630; TR-19) Avail: NTIS CSCL 7/3

The autoxidation of a film of atactic polypropylene (APP) in the presence of cobalt salts was studied quantitatively by means of infrared spectroscopy. Reactions were traced as a function of temperature, oxygen concentration and time. Temperatures varied from 100 to 130C and oxygen concentrations from 5 to 100% by volume. A general reaction scheme previously reported by the authors for the uncatalyzed autoxidation of atactic polypropylene was modified to account for the cobalt acetylacetonate-catalyzed autoxidation of APP in the bulk phase. Author (TAB)

N71-12364# Grace (W.R.) and Co., Clarksville, Md. Research Div.
SEPARATION OF VOLATILE RARE EARTH COMPLEXES Final Report, 1 Apr. 1968 - 31 Mar. 1970
Robert M. Murch and Srikant V. Dighe Jun. 1970 121 p refs
(Contract F33615-68-C-1526)
(AD-712076; RES-70-16; ARL-70-0111) Avail: NTIS CSCL 7/1

Work was directed towards investigating the feasibility of extractive fractional distillation as a method of separating mixtures of the tris-bi-dentate rare earth compounds when the chelating agent is 2,2,6,6-tetramethyl-3,5-heptanedione. Attempts to design and construct suitable packed columns for these fractionations did not lead to equipment that was satisfactory. A study of extractive distillation solvents indicated that candidates for this role include dihexyl phthalate, diamyl phthalate, phenylmethylsiloxane, eicosane, Drakeol-5 and Drakeol-7. Pure chelates of nine rare earths were synthesized. Several extractive distillations of binary chelate mixtures were conducted through a Nester-Faust platinum spinning band column. An economic evaluation of the separation of rare earth mixtures by fractional distillation and by extractive distillation was conducted by comparing these processes with the commercially operative ion exchange and liquid-liquid extraction systems. The feasibility of using azeotropic distillation or fractionation of chelate-solvent adduct mixtures was also investigated. Author (TAB)

N71-12365# California Univ., La Jolla. Dept. of Physics.
LOW TEMPERATURE MELTING CURVE OF He3
R. T. Johnson (Ph.D. Thesis Illinois Univ.), O. V. Lounasmaa, R. Rosenbaum, O. G. Symko, and J. C. Wheatley 1969 34 p refs
(Contract AT(11-1)-34)
(UCSD-34-P-143-26) Avail: NTIS

Measurements of the melting curve of He-3 have been made from 3 m K to 40 m K, after cooling the liquid-solid He-3 mixture by the adiabatic solidification method. The slope of the melting curve shows that at the lowest temperature there is a substantial departure of the solid He-3 entropy from R ln 2. This effect is due to nuclear spin ordering. Temperatures below 3 m

K were obtained during compression. By theoretically estimating the melting curve below 3 m K, it is possible to estimate temperatures from pressure measurements. By such means it is estimated that Kelvin temperatures of 1.5 to 2 m K were actually achieved. Author

N71-12366*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXAMINATION OF MOLYBDENUM DISULFIDE WITH LEED AND AUGER EMISSION SPECTROSCOPY
Donald H. Buckley Washington Dec. 1970 17 p refs
(NASA-TN-D-7010; E-5855) Avail: NTIS CSCL 07D

LEED and Auger emission spectroscopy were used to examine the surface of molybdenite crystals, MoS2 compacts, and sputtered films. Exposure of the molybdenite (0001) surface to 5000 Langmuirs of oxygen, ethylene, or ethylene oxide revealed no evidence of chemisorption of these gases. The Auger analysis revealed the presence of silicon and carbon in some of the specimens examined. Rubbing of the molybdenite crystal resulted in distortion of the surface layer which could be removed by heating of the crystal. The molybdenite crystals were cleaved in air yet no evidence for oxygen on the surface was observed. Author

N71-12367# Oak Ridge National Lab., Tenn.
X-RAY DIFFRACTION DATA ON LIQUID WATER IN THE TEMPERATURE RANGE 4C TO 200C
A. H. Narten Jul. 1970 70 p refs
(Contract W-7405-eng-26)
(ORNL-4578) Avail: NTIS

X-ray diffraction data are discussed for liquid water at eight temperatures between 4 C and 200 C, and heavy water at 4 C. Except for one new data set (20 C), the intensity and correlation functions were derived from the tabulated raw data reported previously. The present functions were derived using more accurate values for the atomic scattering amplitudes, and results from small angle X-ray scattering were included. The hydrogen bonds in liquid water form an extensive three-dimensional network, and over short distances from any origin the average deviation from ideal tetrahedral coordination is quite small. However, continuous small variations in instantaneous local environments result in the loss of all positional correlation between molecules a few molecular radii away from any starting point. Author

N71-12368# National Science Foundation, Washington, D.C.
INTERACTION OF ELECTROLYTICALLY DEPOSITED METAL WITH THE CATHODE [O VZAIMODEISTVII ELEKTROLITICHESKI VYDELYAEMOGO METALLA S KATODOM]
K. M. Gorbunova 1970 27 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (USSR), 1938 p 893 904
(TT-70-57026; DMDC-1958) Avail: NTIS CSCL 07D

The interaction of electrodeposited cadmium with the substrate metal of a cathode (a silver-cadmium alloy) was studied under varying conditions of temperature, current density impurities, etc. The electrodeposited cadmium was found to diffuse into the cathode. Author (USGRDR)

N71-12369# Naval Research Lab., Washington, D.C.
PROCEDURES FOR THE ANALYSIS OF METALS, ALLOYS, AND OTHER MATERIALS OF RESEARCH. PART 5: AN INVESTIGATION OF THE CHEMICAL ANALYSIS OF CADMIUM-ZINC ARSENIDE Progress Report
O. R. Gates and R. W. Black 17 Sep. 1970 24 p refs
(AD-713062; NRL-7146; PR-5) Avail: NTIS CSCL 7/4

Cadmium-zinc arsenide was analyzed by a combination of chemical and instrumental techniques. After the initial removal of arsenic by distillation, cadmium and zinc are determined by a combined gravimetric and atomic absorption spectrophotometric procedure or by a polarographic procedure. The experimental procedures for determining each of the three major constituents are given in detail. Methods used for checking the effectiveness of their respective separition are also discussed. Author (TAB)

N71-12370*# California Univ., Berkeley. Sea Water Conversion Lab.
STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Quarterly Report, July 1970
K. S. Spiegler, J. C. T. Kwak, D. A. Zelman, and J. Leibovitz 15 Jul. 1970 24 p refs Prepared for JPL
(Contract NAS7-100; JPL-952109)
(NASA-CR-111598; QR-10) Avail: NTIS CSCL 07D

A complete series of transport measurements achieved by the concentration-clamp technique is described. The following measurements were performed: (1) dialysis-osmosis; membrane bounded by 0.5 M and 0.1 M NaCl solutions, (2) electromigration-electroosmosis with a concentration gradient, (3) pressure permeation with a concentration grandient, and (4) combined experiment in which differences in concentration, pressure and electrical potential were applied simultaneously. The same specimen of AMF C-103 cation-exchange membrane was used throughout all the experiments. All the phenomenological coefficients can be calculated from these data, except for the membrane conductance. Additivity of salt and water fluxes was also checked. Further studies under hydrostatic pressure confirm previous observations of a decrease in hydraulic permeability as a result of the pressure gradient applied across the membrane. Although the membrane tested is relatively sturdy, the results indicate that the transport coefficients are functions of the generalized forces themselves. Author

N71-12371# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NITRIDES
G. V. Samsonov 9 Jul. 1970 528 p refs Transl. into ENGLISH of the publ. 'Nitridy' Kiev, 'Naukova Dumka', 1969 p 1-380
(AD-712413; FTD-MT-24-62-70) Avail: NTIS CSCL 7/2

Contents: The structure and properties of nitrides; Methods of preparing nitrides; Metal nitrides of Group I of the periodic system; Metal nitrides of Group II of the periodic system; Nitrides of transition metals; Nitrides of elements of the boron subgroup; Nitrides of elements of the carbon subgroup; Nitrides of elements of the subgroup of nitrogen and other elements; Complex nitrides; Nitride coatings; Regions of the application of nitrides. TAB

N71-12372# Georgia Inst. of Tech., Atlanta.
AFOSR CONTRACTORS' 11th MEETING ON KINETICS OF ENERGY CONVERSION: ABSTRACTS OF PAPERS
1970 42 p refs Conf. held at Atlanta, 3-4 Sep. 1970
(Grant AF-AFOSR-1308-67)
(AD-712738; AFOSR-70-2232TR) Avail: NTIS CSCL 7/4

The report consists of the agenda and abstracts of papers presented at the Eleventh Annual Contractors Meeting on Kinetics of Energy Conversion. The abstracts describe work now in progress under the sponsorship of the Energetics Division, Directorate of Aeromechanics and Energetics, AFOSR. Subjects discussed in the papers included the following: hydrogen-oxygen reactions, fluorine reactions, reactions in flames, atomic and molecular beam studies, combustion kinetics, matrix isolation studies, propellant sensitivity, vibrational and electronic relaxation, and lifetimes of metastable species. Author (TAB)

N71-12373# Princeton Univ., N.J. Dept. of Chemistry.
INORGANIC STRUCTURE AND SPECTRA AND PARAMAGNETIC ANISOTROPY IN COMPLEXES Final Technical Report, 1 Jan. 1963-30 Sep. 1969
William De W. Horrocks, Jr. 30 Sep. 1969 11 p
(Contract AF 49(638)-1492; Grant AF-AFOSR-0242-63)
(AD-711237; AFOSR-70-2327TR) Avail: NTIS CSCL 7/2

A summary is given of work in the following areas: single crystal paramagnetic anisotropy, single crystal x-ray structure determination, vibrational spectroscopy and synthesis, infrared solvent effects, complexes of phosphorus donor ligands. Twenty six resulting publications are listed. Author (TAB)

N71-12374# Sandia Corp., Albuquerque, N.Mex.
EXPERIMENTAL THERMOCHEMISTRY AT HIGH TEMPERATURES
O. Kubaschewski 1970 38 p refs Transl. into ENGLISH from Naturwissenschaften (West Germany), v. 55, 1968 p 525 - 533
Sponsored by AEC
(SC-T-70-4028) Avail: NTIS

A state-of-the-art review is presented on high-temperature thermochemistry. Developments and progress in the field over the past 25 years are outlined and recommendations for future studies are given. D.L.G.

N71-12375# Stevens Inst. of Tech., Hoboken, N.J.
EFFECT OF OXIDATION-REDUCTION POTENTIAL ON THE METAL SALT-CATALYZED AUTOXIDATION OF ATACTIC POLYPROPYLENE
B. R. Jadrnicek, S. S. Stivala, and Leo Reich 3 Aug. 1970 10 p refs
(Contract N00014-68-A-0131)
(AD-711629; TR-18) Avail: NTIS CSCL 7/3

The purpose of the paper was to establish an order of metal catalyst activity during the autoxidation of atactic polypropylene films by measuring carbonyl formation, and to correlate such activity with oxidation-reduction potential. Author (TAB)

N71-12376# Naval Postgraduate School, Monterey, Calif.
IONIZATION POTENTIALS, EXPERIMENTAL AND THEORETICAL, OF THE ELEMENTS HYDROGEN TO KRYPTON
Raymond L. Kelly and Don E. Harrison, Jr. 30 Jul. 1970 32 p refs
(AD-712454; NPS-61-Ke70071A) Avail: NTIS CSCL 7/4

The ionization potentials of the isoelectronic sequences Helium through Zinc have been calculated by the Hartree-Fock method and compared with experimental results. Tables are presented showing the ionization potentials, as observed and extrapolated, for all stages of ionization of the first 36 elements. Author (TAB)

N71-12377# Georgia Univ., Athens. Dept. of Chemistry.
COORDINATION COMPOUNDS OF THE TRANSITION METALS Final Report, 1 Jan. 1968 - 30 Jun. 1970
R. B. King Sep. 1970 33 p
(Grant AF-AFOSR-1435-68)
(AD-712739; AFOSR-70-2478TR) Avail: NTIS CSCL 7/2

The base-catalyzed addition of phosphorus hydrogen and arsenic hydrogen bonds to the carbon carbon multiple bonds in vinyl phosphines and ethynyl phosphines provides a useful new method for the synthesis of novel polytertiary phosphines and phosphine arsines. Using this method large quantities of tritertiary phosphine, two isomeric tetratertiary phosphines, and hexatertiary phosphine were prepared and studied. The preparative method also provides convenient syntheses of the mixed phosphine arsines. A similar base-catalyzed addition of (C6H5)2EH (E = P or As) to vinyl isocyanide gives novel isocyanide derivatives. However, base-catalyzed addition of C6H5PH2 to vinyl isocyanide results in 1,4-addition to give the new phosphorus carbon nitrogen heterocycle 1-phenyl 4,5-dihydro 3-azaphosphole. The transition metal complexes of the ligands are also described. Author

N71-12378# Virginia Univ., Charlottesville. Dept. of Chemistry.
SMALL CARBORANE METALLOCENE ANALOGS. IRON PI-COMPLEXES CONTAINING THE NIDO-C2B4H6(-2) AND CYCLO- C2B3H7(-2) LIGANDS
Russell N. Grimes Oct. 1970 10 p refs
(Contract N00014-69-A-0080-0003)
(AD-712540; TR-6) Avail: NTIS CSCL 7/2

New carborane-transition metal pi-complexes involving the nido-C2B4H6(2-) and cyclo-C2B3H7(2-) ligands have been synthesized from iron pentacarbonyl and 2,3-dicarba-closo-hexaborane(6) in a heated tube, and the structures have been assigned on the basis of boron-11 and proton nmr spectra, as well as infrared and mass spectroscopic evidence. Author (TAB)

N71-12379# Wisconsin Univ., Madison. Dept of Chemistry.
ISOLATION AND CHARACTERIZATION OF TWO NEW ISOMERS OF (B5H8)2
Donald F. Gaines, Terry V. Iorns, and Elna M. Clevenger Sep. 1970 13 p refs
(Contract N00014-67-A-0128-0008)
(AD-712549; TR-3) Avail: NTIS CSCL 7/2

A Description of the isolation and characterization of 2-(2-pentan(9)yl)pentaborane(9), 2,2-(B5H8)2, and 1-(2-petaboran (9)yl)pentaborane(9), 1,2(B5H8)2, from the low volatility residues found in pentaborane(9). Author (TAB)

N71-12380# Rocket Propulsion Establishment, Westcott (England).
DERIVATION OF CHEMICAL REACTION RATE CONSTANTS FROM COMPLEX CONCENTRATION-TIME DATA
R. C. Golesworthy and J. M. Ridout Feb. 1969 34 p refs
(RPE-TR-69/3) Avail: NTIS

A method is given for the calculation of the best-fit set of rate constants for a scheme of simultaneous chemical reactions which models a set of experimentally measured concentration-time relationships. Author

N71-12381# Royal Aircraft Establishment, Farnborough (England).
THE DETERMINATION OF CHAIN STRUCTURE OF POLYNUCLEAR COMPOUNDS BUILT UP OF P-CRESOL AND FORMALDEHYDE. PART 5: BY MASS SPECTRA [DER NACHWEIS DER KETTENSTRUKTUR VON AUS p-KRESOL UND FORMALDEHYD AUFGEBAUTEN MEHRKERNVERBINDUNGEN. 5: DURCH MASSENSPEKTREN]
H. J. Eichoff et al Jul. 1970 22 p refs Transl. into ENGLISH from Makromol. Chem. (Basel), v. 132, 1970 p 163 - 177
(RAE-Lib-Tran-1480) Avail: NTIS

Mass spectra were taken of 17 phenolic polynuclear compounds built up of p-cresol and formaldehyde with molecular weights up to 986. With the aid of these spectra the molecular weights and the most probable molecular formulae of the compounds were determined. Various schemes of fragmentation were drawn up, according to which the peaks in the spectra could be assigned to certain structural elements. By this procedure, typical fragments for various groups of compounds could be found which made a unique characterization possible. From the mass spectra it was also possible to estimate the purity of the compounds under investigation. Author

N71-12382# California Univ., Livermore. Lawrence Radiation Lab.
KINETICS OF ANODIC OXIDATION OF NITROUS ACID AND NITRITE IONS ON A PLATINUM ELECTRODE
Edmond Julien et al 1970 13 p refs Transl. into ENGLISH from Rev. Chim. Miner. (France), v. 6, 1969 p 885 - 900
Sponsored by AEC
(UCRL-Trans-10474) Avail: NTIS

Results in the pH range considered (0-7) show that the dissociation pK of nitrous acid provides a means of distinguishing in potentiometric experiments between two domains of variation of the electrode potential. A pH < pk: E = 0.864 - 0.059 pH

0.0295 log HNO3; at Ph>pK: E = 0.965 - 0.059 pH. The experiments demonstrate that the two overall reactions which occur in several steps, involve the same intermediaries. Two of the various possibilities are consistent with the results: (1) formation of N2O3 by rapid chemical reaction preceding charge transfer; and (2) formation during the transfer step of the neutral species HNO3, which rapidly dissociates in a following step to charge transfer. The kinetics are controlled by diffusion of the species discharge at the electrode, and a chemical reaction precedes charge transfer. The observations are in agreement with potentiometric experiments, and particularly with the possibility of formation of N2O3. D.L.G.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N71-12383# Norges Tekniske Hoegskole, Trondheim. Inst. for Radioteknikk.

THE CROSSED DIPOLE AS AN ANTENNA ELEMENT IN AN ARRAY [KRYSSET DIPOL SOM ELEMENTANTENNE I ET ARRAY]

J. Kuhnle and O. H. Longva Mar. 1969 28 p refs In NORWEGIAN; ENGLISH summary Sponsored by Roy. Norweg. Council for Sci. and Ind. Res.

(ELAB-IR-124) Avail: NTIS

The possibility of constructing a radiation element for an antenna array, especially with regard to the influence of a final ground plane, a final dipole thickness, and type of feeding structure on the radiation diagram and the impedance is discussed. Author (ESRO)

N71-12384# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

STUDY OF THE MEASURING ACCURACY REQUIRED IN RADAR EQUIPMENT FOR BALLISTIC TRAJECTORY ACQUISITION [STUDIE UEBER DIE ERFORDERLICHEN MESSGENAUIGKEITEN VON RADARANLAGEN ZUR ERFASSUNG BALLISTISCHER BAHNEN]

H. Hissen May 1969 65 p refs In GERMAN Sponsored by Bundesmin. fuer Verteidigung

(Rept-1-1969) Avail: NTIS

In order to determine the impact location of ballistic missiles as early as possible after starting time the radar measurements must show a high accuracy in range, elevation, and azimuth angle measurements. A method of numerical trajectory calculations from the radar data is described. Binomially distributed errors are then superimposed on these data to obtain the probability of erroneous impact area prediction. ESRO

N71-12385# Norges Tekniske Hoegskole, Trondheim. Inst. for Radioteknikk.

FEEDING NETWORK FOR ANTENNA ARRAY [MATENETTVERK FOR ARRAYANTENNER]

H. M. Fjoesne, J. Kuhnle, and O. H. Longva Mar. 1969 68 p refs In NORWEGIAN; ENGLISH summary Sponsored by Roy. Norweg. Council for Sci. and Ind. Res.

(ELAB-IR-123) Avail: NTIS

Antenna array feeding networks based on strip conductors are discussed. A short description is given of the system with a basic circuit diagram for a 4 x 4 array network, and a more detailed treatment of the various components including 50 ohm terminations, baluns, and hybrids as well as transfers to other components as coaxial and parallel lines. ESRO

N71-12386# National Aviation Facilities Experimental Center, Atlantic City, N.J.

EXPERIMENTATION SUPPORT FOR DEVELOPMENT OF LOW COST TV RADAR REMOTING SYSTEM Final Report, Jul. 1968 - Feb. 1970

Max Greenberg Dec. 1970 82 p refs

(FAA-NA-70-52; FAA-RD-70-74) Avail: NTIS

Test and experimentation were conducted on an engineering model microwave relay remoting system to obtain data to finalize the system design requirements. Measurements and calculations for received signal levels, fade margins, signal plus noise-to-noise ratio, noise figure and others were obtained. Measured values of the signal levels for a dish-to-dish antenna configuration were in agreement with the theoretical values, whereas the measured values for the periscope antenna configuration used showed a 5 dB discrepancy to the predicted values. An analysis of this discrepancy is covered in the report. In general, the microwave receiver and transmitter characteristics met the equipment procurement specifications. Author

N71-12387*# RAND Corp., Santa Monica, Calif.

ACQUISITION BEHAVIOR OF SOME ADAPTIVE ARRAYS

W. Doyle Oct. 1970 31 p refs

(Contract NASw-1952)

(NASA-CR-111617; R-538-NASA) Avail: NTIS CSCL 09E

The study on the technology of communications satellites concerns adaptive array antennas that appear to offer attractive solutions to the problems of operating earth receiving antennas which must share spectrum use with terrestrial services producing strong interfering signals. The earth receiving antennas continually adjust or adapt their patterns to provide the best discrimination in favor of the wanted signal from the satellites. If the interfering signals are changing, or if the earth antenna is changing in orientation or location, it is important for the adaptive system to have an appropriate response — or behavior with time. Author

N71-12388# Army Electronics Command, Fort Monmouth, N.J.

MULTIBAND HF ANTENNA

Robert E. Whitman Sep. 1970 16 p

(AD-712976; ECOM-3333) Avail: NTIS CSCL 9/5

An experimental analysis in the 2 MHz frequency range is performed on a multiband HF antenna which contains a two, three, or four dipole array. The antenna design equations and bandwidths are determined. The effects of dipole, feedpoint, and frequency separation on the design parameters are noted. Inverting the dipole array from the commonly used configuration is shown to significantly improve the antennas gain. Author (TAB)

N71-12389* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

OPTICAL COMMUNICATIONS SYSTEM Patent

Numa E. Thomas, inventor (to NASA) Reissued 25 Mar. 1969 (Filed 26 Apr. 1968) 9 p Cl. 250-199; Int. Cl. H04b9/00 Original US Patent No. 3,215,842; US Patent Appl. SN-274065, issued 2 Nov. 1965 (Filed 18 Apr. 1963)

(NASA-Case-XLA-01090; US-Patent-RE-26,548; US-Patent-Appl-SN-741824) Avail: US Patent Office CSCL 20E

A semipassive communications system is described in which intelligence is transmitted from one site to a second site by means of modulating a light beam. Some of the characteristics of this new system are: (1) cannot be monitored by anyone not authorized to receive the message; (2) can be operated by a novice under emergency conditions; (3) no frequency allocations required; (4) transmission of intelligence by modulation of a beam of light; and (5) provision of a long-lived passive modulator device requiring no setup time or maintenance for use in the system. Detailed drawings of the system and its component parts are included and fully described in the text. A.L.

N71-12390* Northeastern Univ., Boston, Mass.
PULSE-WIDTH MODULATION MULTIPLIER Patent
Arthur William Carlson and Charles A. Furciniti, inventors (to NASA) Issued 20 Oct. 1970 (Filed 13 Sep. 1967) 6 p Cl. 332-9; Int. Cl. H03k7/08 Sponsored by NASA
(NASA-Case-XER-09213; US-Patent-3,535,657; US-Patent-Appl-SN-668302) Avail: US Patent Office CSCL 09E

A device is described for increasing, multiplying or amplifying, by some constant factor, the width modulation of a pulse width modulated signal wherein the output pulse train has a greater degree of width modulation than the input width modulated signal. The input width modulated signal pulse train is first integrated by a suitable RC network, the time constant thereof being chosen, with respect to the pulse repetition frequency of the input signal, to provide an essentially peaked signal. The peaked signal, when applied as an input to a trigger circuit, causes the circuit to switch from one output level to another to generate the required modulated output signal. Author

N71-12391* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DYNAMIC DOPPLER SIMULATOR Patent
Jack W. Seyl and Jan W. Martin, inventors (to NASA) Issued 7 Oct. 1969 (Filed 30 Oct. 1968) 13 p Cl. 343-17.7; Int. Cl. G01s7/40
(NASA-Case-XMS-05454-1; US-Patent-3,471,858; US-Patent-Appl-SN-771803) Avail: US Patent Office CSCL 09E

Apparatus for testing ground station ranging equipment and cooperating spacecraft transponder equipment, both of which are ground based and stationary during the testing process, is described. The equipment includes a first frequency translator for transferring a code modulated radio frequency ranging signal from the ground station transmitter to the receiver portion of the spacecraft transponder. This first frequency translator operates to shift the frequency of the radio frequency carrier to simulate an up-link Doppler effect which might be encountered in actual space flight. Also included are circuits which are coupled to the modulation signal generating portion of the ground station transmitter for shifting the frequency of the modulation signal components by an amount representing the corresponding Doppler effect on the radio frequency carrier sidebands produced by such modulation components. A time delay means and a second frequency translator are also included in the system. A.L

N71-12392* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BI-POLAR PHASE DETECTOR AND CORRECTOR FOR SPLIT PHASE PCM DATA SIGNALS Patent
James W. Bailey, Louis A. Koschmeder, and Donald F. McAfee, inventors (to NASA) Issued 20 Jan. 1970 (Filed 30 Sep. 1966) 6 p Cl. 178-88; Int. Cl. 04l15/24, 17/16, 15/00
(NASA-Case-XGS-01590; US-Patent-3,491,202; US-Patent-Appl-SN-584067) Avail: US Patent Office CSCL 09E

A regenerator for providing an established phase to a received split phase PCM data train is described. The data train is sent through a shift register having the same number of registers as bits in the sync word of the data. The shift register is continuously interrogated in parallel to provide pulse output whenever the complement of the desired phase of the sync word is detected. Receipt of the sync word in complemented format is indicative of a 180 degree phase shift. Accordingly this pulse output is caused to switch a gate which ultimately provides for a 180 degree phase shift in the received data. Author

N71-12393# Technische Hochschule Stuttgart (West Germany).
INVESTIGATIONS INTO QUANTIZING NOISE OF PULSE CODE MODULATION AND ITS REDUCTION [UNTERSUCHUNGEN UEBER DAS QUANTISIERGERAEUSCH BEI DER PULSCODE-MODULATION UND DESSEN VERMINDERUNG]
Felix Closs (Ph.D. Thesis, 8 May 1969) 1970 208 p refs In GERMAN
Avail: NTIS

The spectrum of quantizing noise in pulse code modulation is analyzed and the auditory perception of the combination of voice sound and quantizing noise is investigated. From this, an easy and cheap method is derived to reduce the ear loudness of quantization noise by means of pre-emphasis and de-emphasis of the transmitted signal. Another method of encoding for transmitting only the differences between samples is investigated. ESRO

N71-12394*# Alabama Univ., University. Coll of Engineering.
ANTENNA ARRAYS: EFFICIENCY AND EFFICIENCY IMPROVEMENT THROUGH COMPENSATION
James E. Dudgeon 1 Oct. 1970 107 p refs
(Contract NAS8-25894)
(NASA-CR-102955; TR-1) Avail: NTIS CSCL 09E

Design procedures for compensating the elements in a phased array antenna for impedance changes with scan angle are presented. With proper compensation it is possible to improve the overall array efficiency and in many instances to increase the usable scan range for the array. A survey is included of the design results for scanned array antennas and a coverage of the factors affecting array efficiency changes with scan angle such as mutual coupling, element placement, surface wave coupling, and polarization. Two basic approaches to compensation for impedance variations with scan angle are detailed. The first considers the effects of structures which modify the array environment such as baffles and dielectric cover sheets. The other deals with methods which depend on behind-the-array circuitry for matching. Author

N71-12395# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A COMPARISON BETWEEN MONOSTATIC AND BISTATIC SCATTERING FROM RAIN AND THIN TURBULENT LAYERS
R. K. Crane 6 Oct. 1970 47 p refs
(Contract NAS5-21532)
(NASA-CR-111618; TN-1970-29) Avail: NTIS CSCL 17I

Simultaneous measurements were made of the backscatter cross section and the bistatic scattering cross section. The radar measurements were made at a frequency of 1.3 GHz. The bistatic scattering measurements were made using CW transmission at 7.7 GHz with a 145-km separation between transmitter and receiver. The receive station had a 60-foot antenna, and the transmitter was van-mounted and used either a 6-foot antenna or a standard gain horn. Stable frequency sources were used to allow Doppler shift measurements on the bistatic scattering link. The measurements were made by fixing the pointing angles of the transmit antenna and scanning both the receive antenna and the radar to investigate the dependence of the scattered signals both on scattering angle and on the location of the scatterers. The measurements of the scattering cross section of the thin turbulent layers were made in the near forward direction, the measurements of rain at a large number of scattering angles. System sensitivities allowed the measurement of scattering from turbulent layers at a 10-km height and from rain with a 0.1 mm/hr. rate. Comparisons between the radar and bistatic measurements were in good agreement with the appropriate scattering theories. Author

N71-12396* Hughes Aircraft Co., Culver City, Calif.
HORN FEED HAVING OVERLAPPING APERTURES Patent
Robert T. Clark, inventor (to NASA) Issued 10 Feb. 1970 (Filed 10 Feb. 1969) 6 p Cl. 343-776; Int. Cl. H01q13/00 Sponsored by NASA
(NASA-Case-GSC-10452; US-Patent-3,495,292; US-Patent-Appl-SN-797794) Avail: US Patent Office CSCL 09E

A feed for exciting a Cassegrain reflector system using a center horn and four peripheral horns, symmetrically located about the center horn, is described. Five horn feed arrays for exciting antenna reflector systems are used for monopulse tracking

applications. The two frequencies at which the horn array is excited are relatively wide spaced, a typical example being a 3 to 2 frequency ratio in the microwave spectrum. Responses from the central and peripheral feeds at the receive frequency are combined to derive a sum pattern that has the same beam width as the central horn beam width at the transmit frequency. P.N.F.

N71-12397# Grumman Aerospace Corp., Bethpage, N.Y. System Sciences Section.

ON THE PASSIVITY AND STABILITY OF PROPAGATING ELECTROMAGNETIC WAVES

M. R. Wohlers Nov. 1970 20 p refs Presented at the IEEE Intern. Symp. on Circuit Theory, Atlanta, 9-11 Dec. 1970 Submitted for publication

(RM-489J) Avail: NTIS

The transmission line network describing the propagation of single electromagnetic waves in a waveguide formed by perfectly conducting cylinders is investigated. The primary focus is on the exchange of energy between these waves and the material that fills the waveguide. A wave is said to be passive or active if the net flow of electromagnetic energy associated with it is into or out of the material. The appropriate conditions under which either of the two types of interactions are possible are determined, the conditions being expressed in terms of the propagation constant and the characteristic impedance of the wave. The concepts of passivity and stability are examined as they apply to wave propagation and it is concluded that a passive wave is stable but a stable wave may be active. It is also concluded that the wave fundamental notion in the study of gain mechanisms in wave interactions is that of activity and not instability. Author

N71-12398*# Translation Consultants, Ltd., Arlington, Va.

INVESTIGATION OF THE PASSAGE OF SUPERLONG RADIO WAVES THROUGH THE IONOSPHERE TO THE ARTIFICIAL EARTH SATELLITE COSMOS 142: PRELIMINARY RESULTS [ISSLEDOVANIYE PROKHOZHDENIYA SVERKHDLINNYKH RADIOVOLN CHEREZ IONOSFERY ZEMLI NA ISZ "KOSMOS-142". PREDVARITELNYYE REZULTATY]

V. I. Aksenov et al Washington NASA Dec. 1970 13 p refs Transl. into ENGLISH from Kosm. Issled. (USSR), v. 8, no. 4, 1970 p 571 577

(Contract NASw-2038)

(NASA-TT-F-13413) Avail: NTIS CSCL 17B

The preliminary results of the epxerimental investigation made by Cosmos 142 of the passage of superlong radio waves radiated by ground radio stations on frequencies of 16.1, 31.85, and 42.85 kHz through the ionosphere are given. The special features involved in making the measurements and the instrumentation used are reviewed. The experimental data obtained are compared with the results of theoretical computations. Author

N71-12399# Electromagnetic Research Corp., College Park, Md.

RADIATION FROM SLOT ANTENNAS ON CONES COVERED BY A PLASMA SHEATH. VOLUME 1: INFINITE CONE AND INHOMOGENEOUS PLASMA Technical Report, Mar. 1967 - Nov. 1969

M. Katzin and W. B. Johns, Jr. Kirtland AFB, N.Mex. AFWL Sep. 1970 105 p refs

(Contract F29601-67-C-0060)

(AD-712049; AFWL-TR-69-137-Vol-1) Avail: NTIS CSCL 9/5

The radiation from slot antennas on a cone in the presence of an inhomogeneous sheath is treated. The sheath is considered as being made up of a number of conical layers, each of which is homogeneous. The boundary conditions lead to a system of integral equations, which number 4M+4 for a sheath composed of M conical layers. These are reduced to singular integral equations of Cauchy type, which are solved in iterative fashion. For sufficiently fine stratification of the sheath, the first iteration should suffice. In general, fields of both magnetic and electric types are generated in the presence of a sheath, even though only a field of magnetic type may be generated in free space. For a ring slot, however, in which the excitation is azimuthally symmetrical, only a field of magnetic type is generated even in the presence of a sheath. It is shown that the solution for this case forms the basis of the solution for the general case. For thin layers, however, Taylors series expansions allow all but one of the coefficients to be evaluated in closed form. The far field is found by a multi-dimensional saddle point evaluation. This is illustrated in detail for the free-space case, case, and then the far field patterns in the presence of a sheath are determined. This can be carried out successfully for all components, and to arbitrary orders of iteration. The calculation of input admittance and mutual coupling between transmitting and receiving slots on the cone is formulated and methods of calculation are discussed. Author (TAB)

N71-12400# National Academy of Sciences-National Research Council, Washington, D.C. Committee on Hearing, Bioacoustics, and Biomechanics.

SONAR DETECTION OF SUBMARINES BY HELICOPTER

Aug. 1970 11 p

(Contract Nonr-2300(05))

(AD-711910) Avail: NTIS CSCL 20/1

The report advises the military services concerning means for improving the efficiency of the search technique of sonar operators and crew members involved in searching for submarines by means of helicopter-borne equipment. Measures are also suggested for protecting the hearing of the sonar operator and the crew of the helicopter. Author (TAB)

N71-12401# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

ELECTRICAL INVESTIGATIONS OF RESONATOR ANTENNAS [ELEKTRISCHE UNTERSUCHUNGEN AN RESONATORANTENNEN]

K. Magura Jul. 1968 59 p refs In GERMAN Sponsored by Bundesmin. fuer Verteidigung

Avail: NTIS

The electrical properties of various X band cavity resonators with aperture plates were investigated. The input reflection coefficient, the radiation pattern, gain, and efficiency of these resonators were measured and, if possible, compared with calculated values. The mechanical strength of the resonators was increased by metal posts and a ceramics filling. ESRO

N71-12402# Electromagnetic Research Corp., College Park, Md.

RADIATION FROM SLOT ANTENNAS ON CONES COVERED BY A PLASMA SHEATH. VOLUME 2: FINITE CONE AND HOMOGENEOUS PLASMA Technical Report, Mar. 1967 - Nov. 1969

J. C. Katzin Kirtland AFB, N.Mex. AFWL Sep. 1970 22 p ref

(Contract F29601-67-C-0060)

(AD-712051; AFWL-TR-69-137-Vol-2) Avail: NTIS CSCL 9/5

For very thin plasma sheaths, where the plasma is highly conducting yet the attenuation in penetrating normally through it is small, the sheath produces only a small perturbation in the far field. This is in the order of 5 percent for fields of electric type but is much smaller for fields of magnetic type. For electric type fields, the sheath acts like a weak reactive sheet. A finite cone covered by a highly conducting plasma sheath behaves essentially like an infinite cone. This is due to the fact that the sheath substantially prevents the penetration of fields from the source location on the conical surface around to the back of the cone, so that no currents flow in the back, except for the immediate vicinity of the outer edge. Author (TAB)

N71-12403# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.

BIT ERROR RATES AND TRANSIENT TIMES FOR A

BINARY DIGITAL LOOP BIT SYNCHRONIZER IN ADDITIVE WHITE GAUSSIAN NOISE

James R. Cessna (ESSA) Aug. 1970 39 p refs
(Contract N00014-68-A-0196-0003)
(AD-711957; Rept-70-49) Avail: NTIS CSCL 17/2

A class of digital bit-synchronization phase-locked loops employing binary phase error quantization and sequential loop filtering is described. Two different types of data-derived phase detectors are assumed, one which depends on detection of the occurrence of data transitions and one which does not. Steady state and transient performance is analyzed in the presence of additive white Gaussian noise. This analysis is performed using a finite state periodic Markov model with unequal state duration times. Bit error rates and effective loop noise bandwidths are given.
Author (TAB)

N71-12404# Sylvania Electronic Systems-East, Waltham, Mass. Communication Systems Div.

TROPOSCATTER MULTIPATH ANALYZER. Final Technical Report, 19 Feb. 1969-19 Mar. 1970

Robert Gallant Griffiss AFB, N.Y. RADC Aug. 1970 191 p refs
(Contract F30602-69-C-0079)
(AD-712415; RADC-TR-70-155) Avail: NTIS CSCL 17/2.1

The use of Rake instrumentation as a sounding technique for the troposcatter multipath channel is discussed and the implementation of the Troposcatter Multipath Analyzer is described. The transmitter emits a carrier which is biphase modulated by a pseudorandom code sequence at a selectable rate between 10 and 1.25 MHz. The corresponding multipath resolution is 0.1 to 0.8 microsec. The receiver embodies a unique implementation in which video is detected corresponding to both quadrature components of the incoming signal followed by single-bit polarity sensing. Noise is added to linearize the single-bit sampling. The receiver generates ten time-shifted local copies of the transmitter pseudo-random code and cross correlates these with the sampled video to realize ten Rake taps. The integration period or data sampling rate is selectable as 1.25, 10 or 80 ms. The resultant output of the analyzer consists of samples of the quadrature Rake tape components recorded on magnetic tape for later computer processing. The Multipath Analyzer was exercised over a test path in upper New York State. The test results are presented in the form of an extensive set of three-dimensional scattering functions. These show the distribution of received power as a function of multipath delay time and Doppler frequency. The data records leading to the calculated results were collected during the late Fall of 1969. The highlights of the results are discussed. The scattering functions calculated from data recorded during movement of a cold front through the test path provide a particularly unusual set of results.
Author (TAB)

N71-12405# Army Foreign Science and Technology Center, Washington, D.C.

CORRELATION OF AMPLITUDE AND PHASE SPATIAL FLUCTUATIONS OF WAVE DIFFRACTED ON ROUGH SCREEN [KORRELYATSIYA PROSTRANSTVENNYKH FLUKTUATSII AMPLITUDY I FAZY VOLNY, DIFRAGIROVANNOI NA NEROVNOM EKRANE]

Yuri M. Polishchuk 1 Sep. 1970 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (USSR), v. 11, no. 1, 1968 p 72-83
(AD-712335; FSTC-HT-23-083-70) Avail: NTIS CSCL 20/14

Autocorrelation of fluctuations, as well as the mutual amplitude and phase correlation in a diffracted wave, are examined. The problem is solved in approximation of the small perturbations method for all values of the wave parameter. It is shown that correlation in the Fraunhofer and ray approximation zones does not depend on the mean height of the screen, and increases as the distance between the receivers and the screen increases. Amplitude and phase correlation at the Point of reception diminishes and vanishes in the Fraunhofer zone with increasing distance between the receiving point and the screen. In the range of intermediate values of the wave parameter, correlation is determined by the ratio between the mean scale of irregularities and the radius of the Frennel zone in the region of the screen and depends on the mean height of the screen.
Author (TAB)

N71-12406# Northrop Corp., Palos Verdes Estates, Calif. Electronics Div.

DIGITAL ADDRESS THIN DISPLAY TUBE. Quarterly Progress Report, 16 Feb. - 16 May 1970

W. F. Goede Jun. 1970 33 p
(Contract DAAB07-70-C-0110)
(AD-713025; NORT-70-353-1; ECOM-0110-1; QPR-1) Avail: NTIS CSCL 17/9

The report describes the progress to develop a 32 x 50 resolution element Digital Address thin display tube for a man-pack radar. The feasibility of the approach was studied, a preliminary design was completed, a study of possible area-cathode approaches was completed, fabrication of prototype area-cathodes was initiated, and testing of dynode designing initiated. Of over 20 cathode types studied, 3 were selected for further study and experimentation. All three of these were of the thermionic oxide-coated cathode type. A multifilament flood gun was considered to be the most practical. The other two cathodes selected for evaluation and test are: (1) an oxide-coated screen mesh, and (2) an electroformed filament matrix. To maximize the performance of the dynodes, new hole-geometries are being studied. Evaluation of these new geometries has just begun. The design of minimum-power driving electronics has also begun. Preliminary estimates indicate the design goal of 1 watt total power dissipation is achievable.
Author (TAB)

N71-12407# Naval Weapons Center, China Lake, Calif. Fuze Dept.

CURRENT SYNTHESIS IN A DIRECTIVE, CONTINUOUS-SOURCE ANTENNA WITH SPECIFIED SIDE-LOBE LEVELS ON BOTH SIDES OF THE MAIN BEAM

Arthur P. Boblett Sep. 1970 42 p refs
(AD-712768; NWC-TP-4968) Avail: NTIS CSCL 9/5

A method was developed for finding a current distribution for continuous-source antennas in which the main-beam angle and the side-lobe levels on both sides of the main beam are specified. Other specified parameters are the wavelength of the input energy, the length of the aperture, and the constraints on the current at the ends of the aperture.
Author (TAB)

N71-12408 Houston Univ., Tex.

DESIGN OF OPTIMUM FILTERS FOR ANALOG FEEDBACK TELEMETRY SYSTEM

Syed Zafar Hasnain Taqvi (Ph.D. Thesis) 1969 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 70-4500

An analog feedback telemetry system having noise in both the forward and feedback channels is analyzed. The complete system is treated as a feedback control system with disturbances in forward and feedback loops and technique of calculus of variation is applied to study the optimum performance. Cases of both with and without delay in the channels are considered. The technique evaluates the expressions for optimum filters which minimizes the mean square error between the data sent and the data received. Various cases of correlation between signal and noise processes are considered and expressions of optimum filter transfer functions are derived. Mean square errors are evaluated for various cases of correlation. It is shown that for the systems where noise in the feedback channel is not correlated either with forward channel noise or the signal, a feedback channel is not required for optimum performance. Channel delays could also be adjusted to minimize the mean square error.
Dissert. Abstr.

N71-12409# Stanford Research Inst., Menlo Park, Calif.
PERFORMANCE REPORT ON PROJECT VELA STUDIES Final Report
A. M. Peterson 17 Aug. 1970 5 p
(Contract Nonr-4913(00); ARPA Order 215; Proj. Vela)
(AD-711961) Avail: NTIS CSCL 18/3

The report is a summation of the final reports issued under this contract. The reports include high frequency propagation and ionospheric propagation studies. Author (TAB)

N71-12410# Aerospace Corp., El Segundo, Calif. Lab. Operations.
CHARACTERISTICS OF OVERSIZE CIRCULAR WAVEGUIDES AND TRANSITIONS AT 3 MILLIMETER WAVELENGTHS Technical Report, Jan. 1969 – Mar. 1970
Howard E. King and Jimmy L. Wong 1 Aug. 1970 24 p refs
(Contract F04701-70-C-0059)
(AD-712378; TR-0059(6230-30)-3; SAMSO-TR-70-330) Avail: NTIS CSCL 9/1

The physical and electrical characteristics of a 0.995 in. diameter oversize circular waveguide and its associated transitions operating in the 92- to 96-GHz band are described. Both linear and nonlinear taper transitions were employed in converting from the WR-10 dominant mode rectangular waveguide (0.100 X 0.050 in. ID) to a 0.995 in. diameter circular waveguide. The results of the present investigations indicate that the nonlinear taper transitions yield considerably less multimoding effects. In the 92- to 96-GHz band, the measured attenuation for a 0.995 in. diameter oversize copper circular waveguide is 0.028 dB/ft as compared to a theoretical value of 0.02 dB/ft. Author (TAB)

N71-12411# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
THE STUDY OF THE EFFECTS OF THE QUANTIZATION OF ELECTROMAGNETIC RADIATION ON SIGNAL WAVESHAPES AND COMMUNICATION SYSTEMS Final Report, 1 Sep. 1965 – 30 Jun. 1970
Gerard Lachs 8 Sep. 1970 7 p refs
(Contract DA-31-124-ARO(D)-383)
(AD-712331; AROD-5659.13) Avail: NTIS CSCL 20/13

The problem of deriving a description for the detection of multimode electromagnetic radiation was studied. The analysis of A. M. and F. M. systems using the results of the multimode work were investigated. Quantum mechanical effects upon shot noise, error rates in binary communication systems, radar systems, and the channel capacities of information systems were investigated. In many of the preceeding cases, both photocount detection and real field detection schemes were considered. A considerable attempt was made to obtain a general solution for the photocount statistics of Gaussian light. Author (TAB)

N71-12412 Arizona State Univ., Tempe.
DETECTION AND ESTIMATION OF COMPLEX RADAR MISSILE SYSTEM TARGETS IN A CLUTTER AND NOISE ENVIRONMENT
Lawrence Edward Langley (Ph.D. Thesis) 1969 295 p
Avail: Univ. Microfilms: HC $13.30/Microfilm $3.80 Order No. 70-4869

Optimum processor performance based on a point-target return in an environment of clutter and noise interference is severely degraded when the actual target return consists of multiple-point reflectors varying in both amplitude and time of arrival. These reflection characteristics are typical of radar missile system targets illuminated at carrier frequencies in excess of 10 GHz. A comprehensive analysis was undertaken to evaluate the effects that an overlapping and nonoverlapping two- and three-point target model had on system performance. Severe system losses were noted for both a pulse Doppler and interrupted continuous wave radar missile system dictating the need for an adaptive processor that is structured to both the interference environment and the complex target characteristics. System performance effects were determined for an optimum processor structured to the clutter plus noise interference, a conventional matched filter receiver encountering both clutter and noise interference, and a matched filter receiver operating in a white noise only environment. Dissert. Abstr.

N71-12413*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
DEFINITIONS IN COMMUNICATION TECHNOLOGY
Sherman Karp Jan. 1968 8 p
(NASA-TM-X-66496; PM-39) Avail: NTIS CSCL 09D

Some of the more common vernacular in communication theory are defined. The emphasis is on signal to noise ratios, bit errors, and quantization. Author

N71-12414# General Instrument Corp., Hicksville N.Y. Electronic Systems Div.
RADAR SET AN/PPS-17(XN-1): FAILURE FREE DEVELOPMENT PROGRAM, PHASE 2: Interim Development Report, 1 – 31 Aug. 1970
Walter Seidman and Al Zecca 31 Aug. 1970 23 p
(Contract N00039-70-C-3501)
(AD-712530; ESD-1158-IR-7) Avail: NTIS CSCL 17/9

Progress is reported on the designing, manufacturing and testing of 20 high reliability radar AN/PPS-17(XN-1). TAB

N71-12415# Texas Univ., Austin. Electronics Research Center.
BROADBAND CONSTANT BEAMWIDTH ACOUSTICAL ARRAYS
Elmer L. Hixson and Kim-Tung Au 1 May 1970 44 p refs
Sponsored in part by Ling-Temco-Vought, Greenville, Tex.
(Grant AF-AFOSR-1792-69)
(AD-712676; AFOSR-70-1649TR; TM-19) Avail: NTIS CSCL 17/2

The beamwidth of most directional receivers decreases with frequency. If broadband signals are used and accurate pointing is not maintained, spectrum shape is not preserved. Constant beamwidth arrays to prevent this problem are proposed here. When the output of an array is combined with the output of a half scale model of the array through the proper filters, constant beamwidth over an octave frequency range results. This process is continued to provide the desired bandwidth. A three element-two octave microphone array is described and its characteristics presented. Although the correct filters were not available, only plus or minus 8 degrees variation in beamwidth from 500 Hz to 2 KHz was achieved. Further study is recommended and application to many systems is suggested. Author (TAB)

N71-13271# Sandia Corp., Albuquerque, N.Mex.
ON THE PERFORMANCE OF SOME SEQUENTIAL MULTIPLE-DECISION PROCEDURES
Thomas S. Edrington (Ph.D. Thesis) Apr. 1970 71 p refs
Sponsored in part by AEC
(PB-192229; SC-RR-70-105) Avail: NTIS CSCL 17I

Samples from k random processes (or populations) are available, k at a time (one from each process), to a receiver or data processor. One process contains a signal; the other k – 1 are statistically-identical noise. The receiver is to select the odd process (locate the signal), with prescribed probability of error. The optimal receiver makes the selection in minimum average time. All computation is done under the hypothesis that the processes sampled are Rayleigh; a method for extrapolating results to other cases is given. The parameter k is allowed to vary from 2 to 1000. A number of methods for estimating average sample number are used to obtain a substantial quantity of numerical results. The several decision procedures are compared on the basis of efficiencies relative to the optimal fixed-sample-size procedure and relative to each other. The variation of the problem that allows all k processes to be statistically-identical noise is discussed. Author (USGRDR)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N71-12449# Freie Univ., Berlin (West Germany).
REAL TIME WHOLE BODY COUNTER-COMPUTER SYSTEM [DER ANSCHLUSS EINES PROZESSRECHNERS AN EINEN GANZKOERPER-AKTIVITAETSZAEHLER]
P. Koeppe Apr. 1970 283 p refs In GERMAN; ENGLISH summary
(BMBW-FBK-70-6) Avail: AEC Depository Libraries

Principles, hardware and software of an on-line, real time, whole-body counter-computer-system are described. Author (NSA)

N71-12450*# Boeing Co., Houston, Tex. Space Div.
INTERSECT NODE/AUTOMATED SNEAK PROGRAM (ASP)
A. R. Guillory Sep. 1970 30 p refs
(Contract NAS9-10364)
(NASA-CR-108724; D2-118307-1) Avail: NTIS CSCL 09B

The Intersect Node (INODES1) Program belongs to regeneration phase of the Automated Sneak Program (ASP). The program will create a partial reverse for each branch, determine intersect nodes by the three branch rule and mark those intersect nodes for later regeneration processing. Author

N71-12451*# Boeing Co., Houston, Tex. Space Div.
LEGAL PATH REPORT/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 34 p refs
(Contract NAS9-10364)
(NASA-CR-108741; D2-118225-1A) Avail: NTIS CSCL 09B

Legal path reporting is the final step in regeneration of paths in complete path form. The records are input one complete path at a time, formatted, and written on the system output unit. In addition, a new tape is generated and passed to the remaining regeneration phase programs. Author

N71-12452*# Boeing Co., Houston, Tex. Space Div.
NODE REPORT DATA GENERATION/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 47 p refs
(Contract NAS9-10364)
(NASA-CR-108742; D2-118226-1A) Avail: NTIS CSCL 09B

This program processes the power/ground paths input master tape, generated by the legal path report by collecting branches required to draw and label network trees. Branches required to draw the trees are written on the total tape and passed to the intersect and special node report program and the diode/load - special node program. Author

N71-12453*# Boeing Co., Houston, Tex. Space Div.
INLINE DISCONNECT/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 22 p refs
(Contract NAS9-10364)
(NASA-CR-108735; D2-118218-1A) Avail: NTIS CSCL 09B

The program provides continuity through the data, thus enabling the Path Derivation Program to find electrical current paths which exist in the spacecraft. These paths may be analyzed to locate potential sneak circuits. Author

N71-12454*# Boeing Co., Houston, Tex. Space Div.
REGENERATED-1/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 27 p refs
(Contract NAS9-10364)
(NASA-CR-108739; D2-118222-1A) Avail: NTIS CSCL 09B

The REGEN-1, the third step in regenerating the paths found, was written in COBOL for IBM 360 digital computer. This program combines the data associated with each branch in the cross reference table with the path number and element number associated with each branch on the path tape output. Each of the input was sorted in ascending branch sequence to facilitate sequential processing. Author

N71-12455*# Translation Consultants, Ltd., Arlington, Va.
THE PRAGMATIC ASPECT OF SCIENTIFIC INFORMATION (METHODOLOGICAL PROBLEMS) [PRAGMATICHESKIY ASPEKT NAUCHNOI INFORMATSII (METODOLOGICHESKIYE PROBLEMY)]
A. D. Ursul Washington NASA Dec. 1970 22 p refs Transl. into ENGLISH from Nauch.-Tekh. Inform., Vses. Inst. Nauchn. Tekn. Inform., Ser. 2 (Moscow), Vol. 8, 1968 p 3-8
(Contract NASw-2038)
(NASA-TT-F-13404) Avail: NTIS CSCL 09D

An interrelation between semantic and pragmatic properties of scientific information is postulated. Possible classifications of scientific information values are discussed. A methodological analysis of three approaches to the mathematical concept of information value is given and, by analogy, some propositions concerning measurement of scientific information value are expressed. Author

N71-12456*# Boeing Co., Houston, Tex. Space Div.
BID PREPROCESSOR/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 84 p refs
(Contract NAS9-10364)
(NASA-CR-108729; D2-118212-1A) Avail: NTIS CSCL 09B

The BID preprocessor program takes 80-column card input, edits the data for certain types of error conditions, uses the edited transactions to update an existing master file, and creates a complete report and a 149-character master tape which is passed to the BID-BED Merge Program. Each of the above steps also reports error conditions which occur in each phase. This program processes BID data for further use by other programs in the Automated Sneak Program System. Author

N71-12457*# Boeing Co., Houston, Tex.
PATH DERIVATION, AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 64 p refs
(Contract NAS9-10364)
(NASA-CR-108738; D2-118221-1A) Avail: NTIS CSCL 09B

The Path Derivation program is designed to operate as a stand-alone program using data produced by the data reduction phase of the Automated Sneak Program. The program function is to report paths by operating on the branch and node table data sets using the indexed sequential access method. Author

N71-12458*# System Development Corp., Huntsville, Ala.
EXPANDED SPECIFICATIONS FOR EXPERIMENT CONTROL AND DATA PROCESSING REQUIREMENTS, PHASE B
20 Oct. 1970 51 p refs
(Contract NAS8-25471)
(NASA-CR-102917; TM-(L)-HU-033/002/00) Avail: NTIS CSCL 09B

The computer support requirements of a solar astronomy experiment for the manned space station are specified. The primary apparatus and experiment operations are presented, and data processing hardware and software requirements for experiment automation are also specified. Particular emphasis is placed on the software required to process and handle the photographic images produced by the experiment. Author

N71-12459*# Boeing Co., Houston, Tex., Space Div.
AUTOMATED SNEAK PROGRAM, SYSTEM DOCUMENT/ AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 33 p refs
(Contract NAS9-10364)
(NASA-CR-108728; D2-118211-1A) Avail: NTIS CSCL 09B

The overall Automated Sneak Program and the inter-relationship between the program modules within that system are described. The program is written in COBOL (F) for use on the IBM-360 computer for circuit analysis. The method of operation and limitations are presented with the input/output description. Flowcharts are included. F.O.S.

N71-12460*# Boeing Co., Houston, Tex.
INTERSECT AND SPECIAL NODE REPORT AND CONTROL SUMMARY REPORT PROGRAMS/AUTOMATED SNEAKS PROGRAM (ASP)
A. R. Guillory Sep. 1970 61 p refs
(Contract NAS9-10364)
(NASA-CR-108743; D2-118227-1A) Avail: NTIS CSCL 09B

The Intersect and Special Node Report and Control Summary Report programs are described. The Intersect and Special Node Report Program processes the total file generated by the Node Report Data Generation Program. The output consists of a matrix report containing the intersect and special nodes versus the paths that contain them and the Terminal Branch and Switched Branch Control Summary files. Author

N71-12461*# Boeing Co., Houston, Tex.
BRANCH/CROSS REFERENCE TABLE PROGRAM/ AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 32 p refs
(Contract NAS9-10364)
(NASA-CR-108737; D2-118220-1A) Avail: NTIS CSCL 09B

The Branch/Cross Reference Table Program written in COBOL (F) for the IBM-360 accepts output data from the Merge BID/BED Program. This data is processed to create a branch table for the ISAM Table Generation Program and a branch cross reference table for the ASP regeneration programs. Author

N71-12462*# Boeing Co., Houston, Tex. Space Div.
SNEAK UTILITY PROGRAMS/AUTOMATED SNEAK PROGRAM (ASP)
A. R. Guillory Sep. 1970 45 p refs
(Contract NAS9-10364)
(NASA-CR-108725; D2-118308-1) Avail: NTIS CSCL 09B

A description is given of the Automated Sneak Program (ASP) system utility and special purpose programs which are required to successfully perform a spacecraft sneak circuit analysis. Author

N71-12463# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISPLAY OF INFORMATION FROM THE IMMEDIATE-ACCESS STORAGE OF A DIGITAL COMPUTER ON THE SCREEN OF A CATHODE-RAY TUBE
I. A. Artamonov et al 12 Jun. 1970 11 p Transl. into ENGLISH from Raboty po Tekhn. Kibernetike (USSR), no. 2, 1968 p 34-39
(AD-712805; FTD-MT-24-69-70) Avail: NTIS CSCL 9/2

A method for generating computer-programmed readout displays is discussed. The technique uses the storage facilities of the BESM-6 and a standard TV picture tube having a 400 x 400 point raster. It is designed for graphical and alphanumeric displays, up to a maximum of 1200 symbols, including Latin and Cyrillic characters, numbers, and signs. External programs for alphanumerics, for example, are stored four tracks of a BESM-6 drum. A symbol is generated in a sub-raster of 8 x 8 bits, in two drum revolutions; since drum speed is 2850 rpm, full raster rate is 24/sec. A figure shows an example of writing the given Cyrillic. Codes are parallel-stored in a shift register, and then read out sequentially and applied to the display tube electrodes as shown in a figure. Since the drum tracks are in four quadrants, there is an information gap in readout; this is compensated for by forming the main raster in eight 50-line subframes, and backing up the delayed portions by one line, thus eliminating image gap and minimizing flicker. Horizontal lines are one line width apart, and symbols are spaced 1/3 of a symbol width apart. The proposed display method is recommended for its simplicity and flexibility. Author (TAB)

N71-12464*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GODDARD VERSION OF THE SCHUBART-STUMPFF N-BODY PROGRAM
P. A. Comella and B. E. Lowrey Dec. 1970 40 p refs
(NASA-TM-X-65398; X-641-70-453) Avail: NTIS CSCL 09B

The Schubart-Stumpff N-Body program computes solar system orbits of the planets and of bodies of zero mass. It can also be used to solve more general problems in mechanics. A FORTRAN 4 adaptation of the Yale version of the program is available to users from the GSFC documentation center. Primary modifications to the Yale program include simplification of program input and the addition of an option to compute the osculating orbital elements. This report briefly summarizes the major features of the program and the development of the Schubart-Stumpff initial values, discusses the new input requirements and modifications, and presents a sample case for clarification. Author

N71-12465*# Radio Corp. of America, Somerville, N.J. Electronic Components.
MONOLITHIC PARALLEL PROCESSOR, PHASE 1 Final Progress Report, 28 Dec. 1968 - 27 Jan. 1970
27 Jan. 1970 24 p
(Contract NAS5-11577)
(NASA-CR-111602) Avail: NTIS CSCL 09B

A four-bit parallel processor LSI array was designed and fabricated using COS/MOS integrated circuit technology. Functional packaged units were delivered to NASA to demonstrate achievement of Phase 1 goals and to show the applicability of techniques for high yield processing. The design features include the provision for interconnecting groups of parallel processor chips to form an expanded processor of any desired word length. This 800 transistor computer on a chip circuit has the logic capability of a medium size, medium speed, general purpose computer suitable for sophisticated scientific data processing. The demonstration of functional circuits represented a significant milestone in IC technology. Author

N71-12466*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DIGITAL ANALYSIS OF RANDOM DATA RECORDS BY PIECEWISE ACCUMULATION OF TIME AVERAGES
F. R. Krause, J. A. Jones, M. J. Fisher, and J. C. Pooley Washington Dec. 1970 62 p refs
(NASA-TN-D-6073; M-531) Avail: NTIS CSCL 09B

A statistical data reduction program designed to reduce and analyze random data processes without regard to record length is described. By this method, very long records may be processed even when computer storage limitations exist. Additionally, the statistical certainty is constantly checked and updated until the desired statistical accuracies are realized or the data source is exhausted. Consequently, only those data necessary to achieve the desired result are processed. This can achieve a considerable savings in computer time and computing costs. Author

N71-12467# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
TIME SHARING WITH AN EXPLICIT PRIORITY QUEUEING DISCIPLINE

Dyrus R. Mehta Jul. 1970 88 p refs
(Contract DA-31-124-ARO(D)-209)
(AD-712319; DSR-75217; AROD-968-61; TR-54) Avail: NTIS CSCL 9/2

The thesis is a mathematical analysis of a round-robin computer time sharing system which is characterized by homogeneous Poisson arrivals, exponentially distributed service times and an ordered priority queue. Each new arrival buys a position in this queue by offering a non-negative bribe to the manager of the computer facility. The system is modelled as a continuous time stochastic process and is analyzed by the method of imbedded Markov chains. Relevant queueing statistics are identified and derived in terms of system parameters. The sensitivity of these results to changes in key system parameters is investigated through numerical examples. Finally, to maximize the expected revenue per unit time accruing from bribes, an optimization problem is formulated and solved with two of the system parameters as decision variables.
Author (TAB)

N71-12468# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
HIGH-SPEED ELECTRO-ARC PRINTING
Earl H. Cobb (M.S. Thesis) Mar. 1970 66 p
(AD-712008; GE/EE/70-7) Avail: NTIS CSCL 14/5

The study explains the design of a high speed Electro-Arc Printer and the tests conducted to evaluate the design. The tests established that the electro-conductive paper is best suited for use in the Electro-Arc Printer and that 14.9 microjoules of energy are required to print a dot on this paper. These printed dots, properly assembled, will form any numeral or letter of the alphabet. Minimum pulse amplitude necessary to ionize the spark gap is 300 V and the minimum pulse width of 1.79 microseconds is sufficient time to deliver the energy to the paper. The dot size is linearly related to the voltage applied between the gap electrodes. Series resistance in the printing circuit is inversely proportional to the size of the dot printed. Based on the arcing pulse characteristics, the Electro-Arc Printer should be capable of printing 1,500,000 numerals or letters per minute.
Author (USGRDR)

N71-12469# Stanford Research Inst., Menlo Park, Calif.
BASIC THEORIES OF AUTOMATIC COMPUTATION Final Report
Abraham Waksman Aug. 1970 61 p refs
(Contract N00014-69-C-0294)
(AD-712843) Avail: NTIS CSCL 12/1

The research effort under this contract concentrated on obtaining an insight into basic problems defining computation measure. A set of four papers represent the direct outcome of this effort. The first paper entitled On the Complexity of Programs relates succinctly the main conclusion of the investigation. It, in essence, implies that a generalized measure of complexity will not be found using the notion of complexity of programs. Arguments are given why fruitful strategy for future research will be to consider well-defined and relevant subclasses of computation and computation forms for which a natural measure might exist. The second paper is written in the above spirit. It is entitled A Complexity Measure for Finite Automata, and it describes a method for the establishment of a complexity measure for the simplest class of computational devices, namely finite automata. This measure is particularly appealing because it implies a reduction to physically realizable canonical form with a natural separation between memory devices and memory-less logic. The third paper entitled On Winograds Algorithm for Inner Products, relates an important result in the quest for better procedures for operating on matrices. This result only adds a little to an area where much more knowledge is needed for efficient computation.
Author (TAB)

N71-12470# Texas Univ., Austin. Electronics Research Center.
A STUDY OF GENERAL SYSTEMS USING AUTOMATA THEORY
Raymond T. Yeh 3 Aug. 1970 25 p refs
(Grants AF-AFOSR-1792-69A; NSF GJ-786)
(AD-712440; JSEP-TR-96; AFOSR 70-2052TR) Avail: NTIS CSCL 6/4

Adaptive and goal-seeking systems are formulated in terms of time-variant automata. It is shown that by applying the structural theory of automata, goal-seeking automata can be decomposed into smaller goal-dependent automata of the same type.
Author (TAB)

N71-12471*# Boeing Co., Houston, Tex. Space Div.
ISAM TABLE GENERATOR/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 29 p refs
(Contract NAS9-10364)
(NASA-CR-108744) Avail: NTIS CSCL 09B

The ISAM table generator program uses the branch table output from the branch cross reference table program and creates the branch and node tables using the indexed sequential access method.
Author

N71-12472*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HIGH SPEED PPM/DIGITAL SYSTEM
R. K. Kopsidas, R. B. Pincus, and D. L. Harris Oct. 1970 24 p
(NASA-TM-X-65384; X-743-70-388) Avail: NTIS CSCL 09B

A high speed PPM/digital system is discussed. The 5-kHz PPM system can provide up to eight channels, each transmitting an 8-bit hybrid PPM/digital word, thus providing a capability of measuring fast changing data at a rate of up to 90 kHz.
Author

N71-12473*# Boeing Co., Houston, Tex. Space Div.
MERGE BID/BED AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 64 p refs
(Contract NAS9-10364)
(NASA-CR-108736) Avail: NTIS CSCL 09B

This program was written to satisfy the data requirements of the path derivation program between BID (Box-Internal-Data) and BED (Box-External-Data). The processing of the inputs involves merging, node number assignment, and branch switch marking.
Author

N71-12474# Illinois Univ., Urbana. Coordinated Science Lab.
ON DECODING PROJECTIVE GEOMETRY CODES
C. L. Chen Sep. 1970 17 p refs
(Contracts F30602-70-C-0014; DAAB07-67-C-0199)
(AD-712682; R-488; UILU-ENG-70-231) Avail: NTIS CSCL 9/4

The report shows that Projective Geometry codes are orthogonalizable in less than or equal to 3 steps. Thus, this class of codes is majority-logic decodable in no more than 3 steps. The improved decoding algorithm reduces the decoding complexity of Projective Geometry codes enormously in most cases. This should make Projective Geometry codes very attractive for practical use on error-control systems.
Author (TAB)

N71-12475# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
THE DESIGN AND CONSTRUCTION OF FLEXIBLE AND EFFICIENT INTERACTIVE PROGRAMMING SYSTEMS
James G. Mitchell (Ph.D. Thesis) Jun. 1970 281 p refs
(Contract F44620-70-C-0107)
(AD-712721; AFOSR-70-2489TR) Avail: NTIS CSCL 9/2

The dissertation treats interactive programming systems at three levels: (1) the design of an interactive programming system (IPS) from considerations of the psychological and intellectual needs of the user; (2) the implementation of an IPS which is both flexible for the human and efficient with computer usage; and (3) the construction of an IPS by bootstrapping. The bulk of the work centers on the second point. In particular, a method is developed

for building an interpreter for a language (to achieve flexibility) which also yields a compiler for that language as a (relatively cheap) byproduct. Programs become compiled in the process of being interpreted, but are able to respond to changes in the interactive environment as if they were being interpreted only. With such an interpreter/compiler, bootstrapping becomes a visible means of building an IPS. This is especially valuable in making the interfaces between the human and the system easily malleable to suit the users needs and abilities. Author (TAB)

N71-12476# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
TAP AND SCRAP: PROGRAMS FOR PROCESSING DATA FROM AUTOMATIC GAS ANALYSIS EQUIPMENT USING A PDP8 I COMPUTER
R. D. Russel and R. F. Skinner Feb. 1970 56 p refs
(RD/B/N-1581) Avail: AEC Depository Libraries

The PAL 3 symbolic assembler programs TAP and SCRAP provide rapid processing of data, on a PDP8/I computer, from automatic gas analysis equipment used to measure gas composition changes in gas graphite reactions. Assessment of the data, for correct operation of the equipment, is made using TAP while SCRAP converts selected data into working units and presents this information in a tabulated form. Author (NSA)

N71-12477*# Oklahoma State Univ., Stillwater. Coll. of Engineering.
A PILOT PROGRAM FOR SELECTING, EDITING, AND DISSEMINATING ENGINEERING AND SCIENTIFIC EDUCATIONAL SUBJECT MATTER FROM NASA TECHNICAL REPORTS Progress Report, Nov. 1969 – 31 Aug. 1970
31 Aug. 1970 18 p refs
(Contract NSR-37-002-045)
(NASA-CR-111613, ER71-I-9) Avail: NTIS CSCL 09D

Research progress is reported on writing of instructional monographs used in selection, editing, and dissemination of engineering and scientific educational literature from NASA technical reports. The results of responses from users of the program are given in tabular form. Author

N71-12478*# Boeing Co., Houston, Tex. Space Div.
BED UPDATE/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 57 p refs
(Contract NAS9-10364)
(NASA-CR-108734; D2-118217-1A) Avail: NTIS CSCL 09B

The box external data (BED) update program constitutes the BED update part of the data reduction phase of ASP. All preprocessed contractor wire lists are input to the program. The wire list records are merged with input update records from the user to produce an accurate BED master wire list. Author

N71-12479*# Boeing Co., Houston, Tex. Space Div.
G&E PREPROCESSOR/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 46 p refs
(Contract NAS9-10364)
(NASA-CR-108731; D2-118214-1A) Avail: NTIS CSCL 09B

The North American Rockwell ground support equipment preprocessor program is described. This program processes the data on the ground support equipment copper path master wire tape. This tape contains data describing all ground support equipment wiring to the Apollo spacecraft. This program was developed as a part of the Apollo TIE sneak circuit analysis system. Author

N71-12480# National Physical Lab., Teddington (England). Div. of Electrical Science.
FUNCTIONS THAT ARE SOLUTIONS OF A LOGICAL DIFFERENTIAL EQUATION
J. E. Gibbs Apr. 1970 25 p refs Presented at the NPL Colloq. 15 Dec. 1969
(NPL-DES-4) Copyright. Avail: NTIS

A simple account is given of a few of the more elementary properties of functions defined on the non-negative integers less than 2 to the nth power, where n is a positive integer. These integers are the Pichler norms of an n-dimensional Boolean vector space. Such a space plays a leading role in dichotomous pattern recognition, binary digital computation, design of switching systems, and the theories of information, coding, and digital communication. There are also applications in statistics, in the theory of numbers, and, possibly, in physics. Author (ESRO)

N71-12481*# Boeing Co., Houston, Tex. Space Div.
RECFIX/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 38 p
(Contract NAS9-10364)
(NASA-CR-108740; D2-118223-1A) Avail: NTIS CSCL 09B

The Path Record Continuity Generator program is described. This program analyzes all power/power, power/ground, ground/ground, and incomplete paths and assures proper continuity with respect to the 'from' connector. Author

N71-12482*# Boeing Co., Houston, Tex. Space Div.
REQUIREMENTS FOR THE AUTOMATED SNEAK PROGRAM (ASP)
J. P. Rankin 15 Oct. 1970 71 p refs Revised
(Contract NAS9-10364)
(NASA-CR-108727; D2-118081-2B-Rev) Avail: NTIS CSCL 09B

Requirements are given for a digital computer program designed to process Apollo spacecraft electrical data into reports used to assist sneak circuit analysis. The detailed specifications are unique to Apollo, but the concepts and techniques presented herein are adaptable to almost any electrical engineering system analysis or network analysis endeavor. Author

N71-12483*# Boeing Co., Houston, Tex. Space Div.
PATH REDUNDANCY AUTOMATED SNEAK PROGRAM (ASP)
A. R. Guillory Sep. 1970 26 p refs
(Contract NAS9-10364)
(NASA-CR-108722; D2-118305-1) Avail: NTIS CSCL 09B

The PTHRED is the second step in regenerating the paths found and output. This step is also the second of a two-step procedure in finding redundant paths output. Author

N71-12484*# Boeing Co., Houston, Tex. Space Div.
NORTH AMERICAN PREPROCESSOR/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 51 p refs
(Contract NAS9-10364)
(NASA-CR-108730; D2-118213-1A) Avail: NTIS CSCL 09B

The North American preprocessor program processes the wire segments on the North American area master tape by checking them for completeness and/or desirability. This data along with the data from the area master tape allows for the processing of the terminal board items. The output data set is a two-way segment data set which is processed by the BED update program. Author

N71-12485*# Boeing Co., Houston, Tex. Space Div.
GRUMMAN PRE-PREPROP/AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 27 p refs
(Contract NAS9-10364)
(NASA-CR-108733; D2-118216-1A) Avail: NTIS CSCL 09B

The Grumman Pre-Preprop Program produces an initial LM wire list on tape, and also in report form. This initial wire list is processed by the Grumman Preprocessor Program. Author

N71-12486*# Boeing Co., Houston, Tex. Space Div.
PATH REDUNDANCY-1 / AUTOMATED SNEAK PROGRAM (ASP)
A. R. Guillory Sep. 1970 30 p refs
(Contract NAS9-10364)
(NASA-CR-108723; D2-118306-1) Avail: NTIS CSCL 09B

PATHRED1 is the first step in regenerating the paths found and output by the Path Derivation Program. This initial step is also the first of a two step procedure in finding redundant paths caused by a path derivation restart. In addition, this program will make the tree number assignment to the paths beginning with common power points. Author

N71-12487*# Boeing Co., Houston, Tex.
SNEAK CIRCUIT ANALYSIS HANDBOOK
J. P. Rankin and C. F. White 15 Jul. 1970 59 p refs
(Contract NAS9-10364)
(NASA-CR-108721; D2-118341-1) Avail: NTIS CSCL 09B

The concepts of formal engineering analysis to detect, and thus prevent, sneak circuits are presented. Sneak circuits are commonly known as system glitches or electrical anomalies which are not contingent on component failures. It was found that such sneak circuits have distinct, classifiable characteristics which make engineering analysis feasible. These characteristics and methods for their recognition are disclosed herein. Author

N71-12488*# Notre Dame Univ., Ind.
CONVOLUTIONAL CODING TECHNIQUES FOR DATA PROTECTION Quarterly Progress Report
8 Sep. 1969 28 p refs
(Grant NGL-15-004-026)
(NASA-CR-111601) Avail: NTIS CSCL 09B

The development of general inverses for linear sequential circuits (LSC's) and continuous dynamical systems (CDS's) is reported. The construction of an inverse, where one exists, is discussed for an m-input LSC (or CDS) such that each output of the inverse when cascaded with the original system is one of the inputs to the original system delayed by L time units (integrated L times). It is shown that the techniques can be extended to apply to the case when each of the inputs is recovered with individually the least delay (the least integration) rather than with uniform delay (integration). Author

N71-12489# Sandia Corp., Albuquerque, N.Mex.
SPLAT: COMPUTER CODE FOR PREDICTION OF HYDROMETEOR IMPACT EROSION ON HIGH-SPEED SPHERE-CONE VEHICLES
James K. Cole and Molly A. Ellis Aug. 1970 71 p refs
(SC-DR-70-373) Avail: NTIS

SPLAT is a FORTRAN 4 computer code that calculates local surface recessions occurring at the stagnation point and at two arbitrary locations on the afterbody of a sphere-cone vehicle as the result of ice and liquid hydrometeor impacts. The shock-layer effects of deceleration and deflection of liquid and ice hydrometeors and of breakup of liquid hydrometeors are included in the formulation. Operation of the code and the mathematical models employed are described. Author

N71-12490*# Boeing Co., Houston, Tex. Space Div.
DIODE/LOAD: SPECIAL NODE/AUTOMATED SNEAK PROGRAM (ASP)
A. R. Guillory Sep. 1970 76 p refs
(Contract NAS9-10364)
(NASA-CR-108726; D2-118309-1) Avail: NTIS CSCL 09B

A set of programs is presented which will use the output total file generated by the Node Report Data Generator program. The set of programs will generate three reports which aid in the drawing of circuitry paths and trees for sneak circuit analysis. Author

N71-12491*# Boeing Co., Houston, Tex.
GRUMMAN PREPROCESSOR / AUTOMATED SNEAK PROGRAM (ASP)
Sep. 1970 80 p refs
(Contract NAS9-10364)
(NASA-CR-108732; D2-118215-1A) Avail: NTIS CSCL 09B

The purpose of this program is to preprocess the Grumman LM/BED (Box External Data) according to specified edit rules into a suitable format for further processing in the Automated Sneak Circuit Analysis System (ASP). Author

N71-12492# Signals Research and Development Establishment, Christchurch (England).
DELTA MODULATION TECHNIQUES FOR ANALOGUE TO DIGITAL CONVERSION OF SPEECH SIGNALS
R. M. Wilkinson Apr. 1969 32 p refs
(SRDE-69022) Avail: NTIS

The use of delta modulation and deltasigma modulation is considered for the transmission of speech in digital form at digit rates below 40 kb/s. The Variable Slope Delta modulator (VSD-1), and the GEC syllabically companded deltasigma modulators are described. The results of electrical and subjective measurements to compare their performances are also given. Author

N71-12493# Nottingham Univ. (England). Dept. of Mathematics
SPECTRAL ANALYSIS
A. O. Hughes May 1970 40 p refs *Its* Computer Appl. in the Nat. and Social Sci. No. 8
(SA/AOH/1/70) Copyright. Avail: Computer Appl., Nottingham Univ.: 7s

The spectral analysis referred to is a subset of time series analysis concerned with the continuous power spectrum of sets of data in economy rather than the discrete estimates produced by the coefficients of the more usual Fourier analysis techniques. An example is given of the programming in FORTRAN of a problem involving relationships between the key variables of money supply, price level and level of output. These fundamental relationships are investigated using spectral analysis. ESRO

N71-12494* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA PROCESSOR HAVING MULTIPLE SECTIONS ACTIVATED AT DIFFERENT TIMES BY SELECTIVE POWER COUPLING TO THE SECTIONS Patent
Rodger A. Cliff, inventor (to NASA) Issued 20 Oct. 1970 (Filed 9 Jun. 1967) 10 p Cl. 307-296; Int. Cl. H03k1/00
(NASA-Case-XGS-04787; US-Patent-2,535,560; US-Patent-Appl-SN-645584) Avail: US Patent Office CSCL 09B

A data processor is described with a plurality of separate sections whereby data are transferred between sections by supplying power intermittently for relatively short time intervals. Power is switched to the sections by the emitter-collector path of a transistor that remains on after a control waveform has terminated. Steal leading and trailing edges of the control waveform are converted to sloping edges by connecting a capacitor in shunt with the base collector electrodes of the switching transistor. The slope of the switched power is chosen to minimize transient disturbances. The power requirements of the processor are reduced because the several sections are not continuously supplied with power, and the data transfer gates are eliminated. Detailed drawings of the device are included. E.M.C.

N71-12496# Computer Symbolic, Inc., Rome, N.Y.
PROGRAMMING PACKAGE FOR ON-LINE PATTERN RECOGNITION Final Technical Report, Apr. 1969 - Apr. 1970
David B. Connell, David W. Clark, Bruce K. Optiz, Patrick J. Martin, and Monroe Novell Griffiss AFB, N.Y. RADC Aug. 1970 273 p refs

(Contract F30602-69-C-0245)
(AD-712677; CSI-70-20; RADC-TR-70-139) Avail: NTIS CSCL 9/2

The report describes a programming package for on-line pattern recognition. The present OLPARS capability is implemented on the BR-85/CDC-1604B computing system. The first two sections of the report are relative to this implementation. Section 1 is a Users Manual for the Distribution Free Module, and represents a description of the largest single functional program within the OLPARS system. It is through the use of the Distribution Free Logic Design (DFLD) subsystem that the OLPARS user constructs the logic to solve a pattern classification problem. This subsystem, via mathematical/graphical techniques, provides the user with the capability of fitting decision logic to the actual structure of the data. Section 2 is the Distribution Free Module Programmers Guide. The guide provides a system program and subroutine cross reference listing, in effect providing the user with a description of the functions performed by each of the routines within the Distribution free subsystem. Further, the filing system considerations are presented as is a user's guide for the filing system overlay.

Author (TAB)

N71-12496# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

TAPE AND TIME BOUNDED TURING ACCEPTORS AND AFL's

Ronald Book, Shelia Greibach, and Ben Wegbreit May 1970 28 p refs Presented at the 2d ACM Symp. on Theory of Computing, Northampton, Mass., May 1970
(Contract F19628-68-C-0029)
(AD-712704; AFCRL-70-0411; SR-4) Avail: NTIS CSCL 9/2

Complexity classes of formal languages defined by time- and tape-bounded Turing acceptors are studied with the aim of showing sufficient conditions for these classes to be AFLs and to be principal AFLs.

Author (TAB)

N71-12497# Texas Univ., Austin. Electronics Research Center.

ON PERIODICITY OF SEQUENTIAL MACHINES

Ratan K. Guha and Raymond T. Yeh 6 Aug. 1970 38 p refs
(Grants AF-AFOSR-1792-69; NSF GJ-786)
(AD-712596; TR-97; AFOSR-70-2203TR) Avail: NTIS CSCL 9/2

It was shown by Gill and Flexer that the necessary and sufficient condition for the existence of non-trivial periodic decomposition of a sequential machine corresponds to the existence of a non-trivial cyclic partition. The authors have, in this report, characterized the existence or nonexistence of cyclic partitions of machines under various connectedness conditions. Their theory is generalized here using the concept of cyclic covers. As a consequence of this generalization, the open problem posed by Gill and Flexer is solved. Upper bounds of periodicity of sequential machines are obtained, using Sperners theorem. The bound is exact for transient-free machines.

Author (TAB)

N71-12498# Texas Univ., Austin. Electronics Research Center.

ADMAG: ANALOG-TO-DIGITAL CONVERSION ROUTINE FOR THE MONARCH OPERATING SYSTEM

Brooks Fowler and Allen Boger 10 Jul. 1970 23 p refs
(Grant AF-AFOSR-1792-69)
(AD-712674; TM-21; AFOSR-70-2042TR) Avail: NTIS CSCL 9/2

This memorandum presents a brief summary of the problems associated with time and frequency domain representation of sampled data along with a program for analog to digital conversion of data on the XDS 930 computer under the MONARCH operating system.

Author (TAB)

N71-12499# National Bureau of Standards, Washington, D.C.

PROCEEDINGS OF THE CONFERENCE ON IMAGE STORAGE AND TRANSMISSION SYSTEMS FOR LIBRARIES

Final Report

Madeline M. Henderson, comp. Sep. 1970 297 p refs Conf. held at Gaithersburg, Md., 1-2 Dec. 1969
(PB-193692) Avail: NTIS CSCL 05B

The challenge of networking is now being extended to cooperative library and information center systems. There are new demands for improved techniques for image storage and transmission, specifically including automated storage and retrieval of microforms and ultra-microforms and new developments in graphic and facsimile transmission. In the conference, the state of the art and the state of the practice were reviewed as background for considering improvements in systems, experimental projects, and advanced techniques in media, communication facilities, and pictorial data processing. The many problems which remain, and possible future trends in development activities, were also discussed.

Author (USGRDR)

N71-12500* Rocketdyne, Canoga Park, Calif.

FREQUENCY TO ANALOG CONVERTER Patent

Frank S. Hagihara, inventor (to NASA) Issued 20 Oct. 1970 (Filed 27 Jun. 1967) 6 p Cl. 332-31; Int. Cl. H03c1/12; Int. Cl. H03k17/28 Sponsored by NASA
(NASA-Case-XNP-07040; US-Patent-3,535,658; US-Patent-Appl-SN-649357) Avail: US Patent Office CSCL 09B

A frequency to analog converter is described in which the input signals at a varying frequency are converted into two trains of pulses, each pulse in the first train having a delayed corresponding pulse in the second train. A unipolar field effect transistor (FET) is used to interconnect the first and second capacitors. The first capacitor, which is the larger of the two, is charged at a uniform rate by a constant current source. The leading edge of each pulse in the first train switches the FET to an 'on' state to provide a low resistance path between the capacitors, so that the second capacitor assumes the potential of the first capacitor. The trailing edge of the pulse in the first train switches the FET to the 'off' state, to isolate the capacitors prior to the arrival of the leading edge of the corresponding pulse in the second train, which activates a discharging gate to discharge the first capacitor. During each cycle of an input signal, the charge of potential of the second capacitor is directly related to the duration of a preceding cycle of the input signals.

F.O.S.

N71-12501* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALOG TO DIGITAL CONVERTER Patent

Henry Doong, inventor (to NASA) Issued 10 May 1966 (Filed 2 Nov. 1962) 6 p Cl. 340-347
(NASA-Case-XLA-00670; US-Patent-3,251,053; US-Patent-Appl-SN-235162) Avail: US Patent Office CSCL 09B

An improved analog to digital converter is described which converts pulses to frequencies. The pulses, whose amplitudes represent the analog input, are applied to an amplifier; each of the amplified pulses are then stretched to the same width, and applied to a variable impedance for controlling the output frequency of an oscillator.

F.O.S.

N71-12502* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

BINARY NUMBER SORTER Patent

Tage O. Anderson, inventor (to NASA) Issued 6 Oct. 1970 (Filed 5 Oct. 1967) 5 p Cl. 340-172.5; Int. Cl. G06f7/00 Sponsored by NASA
(NASA-Case-NPO-10112; US-Patent-3,533,074; US-Patent-Appl-SN-673226) Avail: US Patent Office CSCL 09B

A relatively simple and highly reliable special purpose device for sorting binary numbers and arranging them in order to magnitude is described. A single word input/output register and a multiword serial memory are circulated in synchronism. The register and memory outputs are applied to a comparator which determines whether the register output word is larger than the memory output word. If it is, the memory word is coupled to the register input and

vice versa. As long as the memory output word is larger, both the register and memory continue to circulate. The device is low cost and high speed, and has the additional ability to operate at a slow rate to match the speed of electromechanical devices. N.E.N.

N71-12503* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LINEAR THREE-TAP FEEDBACK SHIFT REGISTER Patent
Marvin Perlman, inventor (to NASA) Issued 20 Oct. 1970 (Filed 11 Mar. 1968) 6 p Cl. 328-37; Int. Cl. H03k23/00 Sponsored by NASA
(NASA-Case-NPO-10351; US-Patent-3,535,642; US-Patent-Appl-SN-712065) Avail: US Patent Office CSCL 09C

A sequence generator comprising a linear shift register with three-tap feedback logic is considered. It is designed for producing maximal-length sequences. The device is simple and characterized by an autocorrelation function with more than two levels, one of which represents a unique out-of-phase condition. It further includes a distinct value of the 180 deg out-of-phase condition, a characteristic most useful in ranging and sync acquisition. Descriptive drawings are given. E.M.C.

N71-12504* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAGNETIC MATRIX MEMORY SYSTEM Patent
George A. Bailey, inventor (to NASA) Issued 3 Feb. 1970 (Filed 28 Mar. 1967) 8 p Cl. 340-174; Int. Cl. G11b5/62
(NASA-Case-XMF-05835; US-Patent-3,493,942; US-Patent-Appl-SN-627257) Avail: US Patent Office CSCL 09B

The magnetic memory matrix system comprises an improved circuit arrangement for the nondestructive reading of the information contained in the matrix. The use of single aperture magnetic core pieces for fabricating the matrix is made possible by simultaneously transferring the information being read to a core that has previously been read and transferred. The programmer supplies a series of actuating pulses at predetermined time intervals, and is particularly adapted for use on aerospace vehicles. Detailed drawings are included. E.M.C.

N71-12505* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BINARY SEQUENCE DETECTOR Patent
Marvin Perlman, inventor (to NASA) Issued 3 Feb. 1970 (Filed 9 Sep. 1966) 10 p Cl. 340-146.2; Int. Cl. Int. Cl. G08c9/00; Int. Cl. G08b29/00; Int. Cl. G06k21/00 Sponsored by NASA
(NASA-Case-XNP-05415; US-Patent-3,493,929; US-Patent-Appl-SN-578932) Avail: US Patent Office CSCL 09B

A detector is described which has fewer memory elements than conventional detectors for detecting a binary sequence of n subsequences, each of R bits. The number of memory elements is equal to R rather than the usual n-1. To detect the first bit in the sequence, the R memory elements store a subsequence associated with the first bit. As each successive bit is received, logic circuitry is used to modify the subsequence stored in the memory elements. When the logic circuitry receives the nth bit, it provides an output indicating the detection of the sequence. There are R-1 subsequences which can be chosen as the initial state so that complexity of the logic circuitry may be minimized. N.E.N.

N71-12506* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DATA COMPRESSION SYSTEM WITH A MINIMUM TIME DELAY UNIT Patent
Donald J. Spencer, Donall G. Bourke, and Rudolph F. Trost, inventors (to NASA) Issued 20 Oct. 1970 (Filed 9 Nov. 1967) 9 p Cl. 340-172.5; Int. Cl. H04b1/66; Int. Cl. H04j3/18 Sponsored by NASA
(NASA-Case-XNP-08832; US-Patent-3,535,696; US-Patent-Appl-SN-681692) Avail: US Patent Office CSCL 09B

A minimum time delay unit which can be conveniently incorporated in conventional time multiplexed data compression channels is described. The unit minimizes the delay associated with nonredundant data sample transfer from a source through the channel to the data utilization system. The unit includes a memory with a multibit storage word for each one of the data sources. The word has a significance-indicating bit which is set when data is determined by a processor to be nonredundant. The data is transferred to a first-in first-out buffer memory. When the channel is activated to supply data, the unit's memory is searched for a word with a set significance-indicating bit to transfer data directly from a source associated with the word, rather than data from the buffer. N.E.N.

N71-12507* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTEGRATED TIME SHARED INSTRUMENTATION DISPLAY Patent
Jack J. Hatfield, inventor (to NASA) Issued 27 Oct. 1970 (Filed 17 Oct. 1967) 10 p Cl. 340-324; Int. Cl. H04n1/18
(NASA-Case-XLA-01952; US-Patent-3,537,096; US-Patent-Appl-SN-676386) Avail: US Patent Office CSCL 14B

A method of forming instrumentation displays by mixing static and dynamic elements is described for use in aerospace vehicle simulator research. The elements are generated synthetically through the selection and animation of fixed patterns from photographic transparencies. The method comprises the following steps: (1) preparing fixed static and dynamic pattern transparencies from mockup art work; (2) storing the transparencies in the apparatus; (3) selecting the desired patterns by the apparatus; (4) animating selected dynamic patterns; (5) displaying the animated dynamic patterns conjuctively with the static patterns; and (6) controlling the displays in an integrated, time sharing manner. N.E.N.

N71-12508*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
SIGNATURE DATA PROCESSING STUDY. VOLUME 1: SUMMARY Final Report
Cheryl L. Crawford, Robert H. Dye, and David S. Hanson Aug. 1970 213 p refs
(Contract NAS9-9848)
(NASA-CR-108760) Avail: NTIS CSCL 09D

The results are presented of study activities in a program to develop hardware and software facilities necessary to accomplish automatically the extraction of the spectral information from line scanner multispectral image data. The basic objectives of the study were: (1) to explore methods for minimizing the amount of information that must be stored to represent multispectral signature distributions, and to develop quantitative measures of the relative merits of various methods; (2) to explore methods for maximizing the amount of information that can be stored; and (3) to evaluate the feasibility of analog methods for implementing the analytical methods explored to permit real data processing with analog equipment. D.L.G.

N71-12509*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
SIGNATURE DATA PROCESSING STUDY, VOLUME 2: EVALUATIONS AND FLOW DIAGRAMS Final Report
Cheryl L. Crawford and David S. Hanson Aug. 1970 128 p
(Contract NAS9-9848)
(NASA-CR-108761) Avail: NTIS CSCL 09D

A description is presented of the generally applicable software used in the signature data processing study. The material contains analytical descriptions of equations evaluated by the various programs and flow diagrams which indicate how the computations are actually performed. The programs involved in the study include: (1) The data simulation program provides data from known distributions with which to evaluate techniques and software. (2) The factor analysis program is specifically tailored for analysis of multispectral data. (3) The cluster analysis program employs a new

technique for identification of cluster centers in multivariate hyperspace. (4) The classification program is intended for evaluation of the relative performance of various classification techniques. (5) The information divergence program provides several ways of obtaining the probability density function used in the processes. (6) The utility programs perform necessary clerical and data handling services in preparation for the programs that actually perform the multivariate data analysis and classification. D.L.G.

N71-12510*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

SIGNATURE DATA PROCESSING STUDY. VOLUME 3: ENGINEERING SPECIFICATIONS Final Report

Kenneth J. Brenda, David R. Morganstein, and David S. Hanson Aug. 1970 31 p

(Contract NAS9-9848)

(NASA-CR-108762; BSR-2949-Vol-3) Avail: NTIS CSCL 09D

Engineering specifications are presented which describe the steps that would result in the development of a signature data processing system (SDPS). The prescribed steps consist of: (1) preparation of engineering design specifications based on the evaluation of engineering analysis and trade-off study data; (2) preparation of engineering drawings to implement the design specified; (3) fabrication of the SDPS; and (4) implementation of performance and acceptance tests as defined in the design specification. D.L.G.

N71-12511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DATA COLLECTION SYSTEMS FOR DISPERSED TECHNOLOGICAL OBJECTS

K. A. Netrebenko et al 1 Jul. 1970 13 p refs Transl. into ENGLISH of the book "Voprosy Proektirovaniya i Isplozovaniya Elektronnykh Upravlyayushchikh Mashin" Kiev, Naukova Dumka, 1968 p 35-42

(AD-712230; FTD-HT-23-268-70) Avail: NTIS CSCL 9/2

In an industrial supervisory-control system, the information collection can be achieved in three fashions: Each sensor is equipped with an encoder EC which comprised a divider D, a scanning register SR, a modulator M, and an amplifier A; one EC may be connected to several sensors via a distributor which may consist of a number of modulators; each sensor has its M-A null detector, but the balancing circuit (D-SR) is common to a cluster of sensors. The latter circuit can be modified by substituting a clock-pulse distributor for the SR. The above schemes permit easy accommodation between the plant structure and the information-collection structure; they do not require intermediate signal standardizers for connecting to primary sensors. A supervisory-control system is being developed at the Institute of Cybernetics, AN UkrSSR, along the above lines; also, an automatic device for introducing digital sensor information is being developed; serial digital codes are introduced into the control computer via special scanning registers mounted near the computer. Author (TAB)

N71-12512# Army Foreign Science and Technology Center, Washington, D.C.

APPLICATION OF DIGITAL MODELING FOR ANALYZING INTERFERENCE IMMUNITY OF DIGITAL COMPUTERS [PRIMENENIE TSIFROVOGO MODELIROVANIYA DLYA ANALIZA POMEKHOUSTOICHIVOSTI SKHEM ETSVM]

B. I. Belov et al 1 Sep. 1970 13 p refs Transl. into ENGLISH from Izv. Vyssch. Ucheb. Zaved., Priborostr. (USSR), v. 11, no. 7, 1968 p 70-76

(AD-712105; FSTC-HT-23-459-70) Avail: NTIS CSCL 9/2

Application of the digital modeling method in the design of digital computer circuits is proposed for calculation of the probabilities of reductions and multiplicity factors of errors with parallel data input. The use of the method for constant perturbation is explained by way of example of a trigger on semiconductor triodes. The advantages of the method in comparison with analysis of the performance of circuits under the influence of a set of interference sources are examined. Author (TAB)

N71-12602# Autonetics, Anaheim, Calif.

OVERVIEW OF AEROSPACE VEHICLE COMPUTER APPLICATIONS

Richard K. Smyth (Manns (Ralph E.) Co.) and Gordon H. Smith *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 11 p (See N71-12601 03-21)

Avail: NTIS

The development of computer systems for aerospace vehicles is reviewed from the 1950's to the present generation of digital computers. Miniaturization of computer components resulted in application of Kalman filtering techniques to guidance and control. Metal oxide semiconductors are discussed as the next quantum step in sophistication of digital hardware during the 1970's. The improved technologies permit the systems engineer to implement almost any mission functions limited only by the capabilities of the sensors, displays, and human operators. R.B.

N71-12605# International Business Machines Corp., Oswego, N.Y. Electronics Systems Center.

FEDERATED VERSUS INTEGRATED COMPUTER SYSTEMS

James H. Crenshaw *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 16 p refs (See N71-12601 03-21)

Avail: NTIS

As it becomes possible through microminiaturization techniques to provide more digital computing capability in smaller, lighter packages, the aerospace industry is finding it desirable to utilize the advantages of digital computers in more complex and varied applications. The system organizations utilized in such operational systems as the F111-MK2, the A-7D/E, IHASS, and ILASS and the design considerations for various other developmental systems are reviewed. The advantages and disadvantages of the federated and integrated approaches are reviewed from an abstract point of view and then the system dependent variables which must be considered by the designer are discussed to emphasize the real world situation. Such features as vulnerability to the single bullet and graceful degradation are considered along with the queuing theory, waiting time, and loading factor tradeoffs. The important factor of relative cost of the two approaches is also discussed. The final selection may be determined by system dependent factors although customer preference is a major consideration. In general the comparisons presented favor the integrated system with problem size determining whether a single processor or a multiple processor configuration is required. Author

N71-12606# Singer-General Precision, Inc., Binghamton, N.Y. Kearfott Div.

PROGRAMMING CHARACTERISTICS OF FUTURE GUIDANCE AND CONTROL COMPUTERS

Austin J. Maher *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 7 p (See N71-12601 03-21)

Avail: NTIS

The types of difficulties encountered in developing and maintaining airborne computer programs are reviewed. These include problems encountered in the initial development of the system program and the significant changes to the original program based on laboratory and flight tests of the overall system. During this development phase, many system problem solutions result in a hardware/software tradeoff which usually forces a software change since software is more flexible. By assimilating results of previous system development experience and predicting the trends in airborne computer hardware development, characteristics are proposed for future airborne guidance and control computers. The features include word length tradeoffs, type of arithmetic, addressing techniques,

and subprogram linkages, and represent a functional specification for a class of future airborne computers using MSI or LSI techniques. Specific characteristics are presented for an airborne computer designed to meet the given functional specifications. Author

N71-12607# International Business Machines Corp., Oswego, N.Y. Electronics Systems Center.

AEROSPACE COMPUTER WORD LENGTH CONSIDERATIONS

G. W. Braudaway *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 (See N71-12601 03-21) 10 p refs

Avail: NTIS

A number of data-word and instruction-format factors are described that must be considered in selecting a common word length in which both are stored. Examples drawn from avionic navigation computations are used to illustrate the premise that variable word length arithmetic can be used to produce numeric results equivalent to those produced by uniform word length arithmetic while reducing storage requirements substantially. Additional storage savings can result from use of variable length instruction formats. It is recommended that additional emphasis be placed on developing techniques to use variable word length arithmetic and instruction formats efficiently. Author

N71-12609# Ferranti, Ltd., Edinburgh (Scotland). Inertial Systems Dept.

ECONOMIES OF INTERFACING WITH SMALL SENSOR COMPUTERS

K. R. Brown *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 10 p (See N71-12601 03-21)

Avail: NTIS

The newer generation of digital processors indicates that the interface between computer and sensor is the major part of the complete system. This is particularly true in the aircraft navigation field where the trend is toward self-contained systems which include a small digital processor, the sensor computer. To make such self-contained systems economical, it is necessary to restrict the size and cost of the interface coupling the computer to the sensors and to the remaining systems. Certain techniques which reduce the cost of storage within the interface and permit the sharing of expensive high accuracy parts of the circuitry are described. Certain basic design principles and rules are stated, and the use of these rules is illustrated by two examples: the interface with an inertial platform and a synchro/resolver interface unit. Author

N71-12613# Air Force System Command, Wright-Patterson AFB, Ohio. Avionics Lab.

RECENT ADVANCES IN SELF-ORGANIZING AND LEARNING CONTROLLERS FOR AERONAUTICAL SYSTEMS

Cecil W. Gwinn and Roger L. Barron (Adaptronics, Inc., McLean, Va.) *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 15 p refs (See N71-12601 03-21)

Avail: NTIS

The development of various types of learning and self-organizing machines is discussed, with emphasis on a probability state variable machine. A self-organizing controller based on the probability state variable machine is investigated, including some results of flight testing of an elementary version of the controller and certain aspects of the design for a self-organizing control system for on-line optimization of thrust specific fuel consumption in turbopropulsion systems. R.B

N71-12615# Advisory Group for Aerospace Research and Development, Paris (France).

REALIZATION OF NONLINEAR CONTROL METHODS WITH DIGITAL CONTROL UNITS

W. Sobotta and H. J. Berger *In its* The Appl. of Digital Computers to Guidance and Control Nov. 1970 16 p (See N71-12601 03-21)

Avail: NTIS

Some characteristic disadvantages of linear control methods used in conventional control units for attitude stabilization of VTOL aircraft are discussed. A special nonlinear stability augmentation system was tested on the flying bedstead SG 1262 of VFW, Bremen, in order to obtain information on the improvement of handling qualities in VTOL aircraft. The tests show that it is advantageous when the response time is about proportional to the pilot commands. A digital control unit was developed, which, at given sampling time and given maximum control power, yields a response time proportional to the command. The control algorithms were combined in such a manner that both the commands and the disturbances are optimized. The control units are distinguished by a relatively simple setup with few digital computer elements. Author

N71-12619# Messerschmitt-Boelkow G.m.b.H., Ottobrunn (West Germany).

SENSITIVITY ANALYSIS OF APPROXIMATE OPTIMUM GUIDANCE PROCEDURES FOR ON-LINE OPERATION

Eveline Gottzein and Helmut Bittner *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 (See N71-12601 03-21) 23 p refs

Avail: NTIS

Simplified guidance computation schemes are considered for on-line operation. Under the aspect of onboard or ground station computer organization explicit and implicit guidance methods are discussed. Based on computational requirements, possibilities for approximate explicit guidance procedures are compared. Author

N71-12621# Royal Aircraft Establishment, Farnborough (England).

DISPLAY AND INTERFACE IMPLICATIONS IN THE USE OF DIGITAL COMPUTERS

J. G. Carr *In* AGARD The Appl. of Digital Computers To Guidance and Control Nov. 1970 11 p refs (See N71-12601 03-21)

Copyright. Avail: NTIS

In introducing the management type of digital computer into aircraft, there are two important interfaces to consider: that between the man and the computer and that between the aircraft system and the computer. The most versatile means of communication between the man and the computer available at present is the cathode ray tube (CRT) in association with a programmed function keyboard (PFK). The CRT display may use cursive, alpha-numeric, pictorial and TV types of presentation and this enables all the conventional display formats, together with new ones, to be presented as required on the CRT by selection on the PFK. The PFK is a multifunction keyboard which is linked to the computer in such a way that the function of each key and the label associated with it changes according to the mode selected. These keys enable, for example, the appropriate format to be selected, the answers to a number of standard questions to be displayed, or data to be inserted into the computer using the keyboard as a typewriter and the CRT to verify the data before insertion. The information being processed in the management computer originates in sensors in various parts of the aircraft and may be in one of many analog or digital forms. The conversion of signals into a common digital form and their transmission by time division multiplexing along either a wire cable or a fiber optic cable is discussed. Author

N71-12624# Philips Gloeilampenfarbrieken N.V., Eindhoven (Netherlands).

SPACEBORNE COMPUTER FOR ATTITUDE CONTROL AND DATA HANDLING

P. van Otterloo *In* AGARD The Appl. of Digital Computers To Guidance and Control Nov. 1970 15 p (See N71-12601 03-21)

Avail: NTIS

In the Astronomical Netherlands Satellite, which is planned for launch in 1974, an onboard computer is to be provided. This computer consists of two parts, the computer proper and the data memory. The computer, which will be reprogrammable by ground command, serves as a direct digital controller for the attitude control of the satellite and as a data processor for reduction of the experiment data. The data memory serves as a buffer for storage of separate experiment and housekeeping data for a period of 12 hours. Both the computer and the data memory have to be designed to serve weight and power limitation. Author

N71-12631# Electronique Marcel Dassault, St. Cloud (France).
APPLICATIONS OF LSI IN AIRBORNE COMPUTERS
Francois P. Maison *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 9 p refs Sponsored by the Delegation Gen. de la Rech. Sci. et Tech. (See N71-12626 03-10)
Avail: NTIS

Brief accounts are given on LSI technology using MOS structures for airborne computer components. Discussion is centered on arithmetic unit partitioning, control unit partitioning, memories, trends in LSI computers, and systems designer and component manufacturer coordination. E.C.

N71-13128# Boeing Co., Seattle, Wash.
FEASIBLE DIRECTION METHODS
J. Kowalik *In* AGARD Symp. on Structural Optimization Oct. 1970 20 p refs (See N71-13126 03-32)
Avail: NTIS

A survey of feasible direction methods for nonlinear programming is presented. A detailed discussion of the three methods that have been applied successfully in the area of structural optimization is described. Each of the three sections gives a derivation of the method and its computational aspects. Also, some recent, promising versions of these methods are described or indicated. Author

N71-13139# Lockheed-Georgia Co., Marietta.
APPLICATIONS OF COMPUTER GRAPHICS IN STRUCTURAL DESIGN
W. J. Batdorf *In* AGARD Symp. on Structural Optimization Oct. 1970 24 p refs (See N71-13126 03-32)
Avail: NTIS

Several research programs concerned with structural optimization are being carried out. The primary goal of these programs is to automate the design process through interactive graphic displays. This system is frequently referred to as the Computercentric Engineering System. The total design process is considered here, but primary emphasis is placed on the structural aspects of the problem. A computergraphic system is now in use by stress personnel for the analysis and design of two-dimensional structures. Prototype studies leading to the development of this system are outlined, along with the current status of an interactive, three-dimensional, structural analysis program. Interactive graphic methods for setting up extremely large structural networks are examined, and one method for automatically determining an efficient design is suggested, once the design concept is proposed. Author

N71-13141# Rolls-Royce, Ltd., Derby (England). Aero Engine Div.
DESIGNING DISC PROFILES FOR A GAS TURBINE ENGINE USING AN INTERACTIVE GRAPHIC DISPLAY DEVICE
M. A. Bayfield and R. D. McKenzie *In* AGARD Symp. on Structural Optimization Oct. 1970 13 p refs (See N71-13126 03-32)
Avail: NTIS

Described is the early use of a program which an aero engine designer may use to draw a two-dimensional mesh pattern over the profile shape of a rotating disc. The program allows the designer to construct this mesh on the screen of a graphics terminal, at which he may modify the design of both the mesh and the original disc profile. When he is entirely satisfied with each of these he is able to transfer all relevant information about the mesh, together with data describing nodal loads, displacements, pressures and stalking properties to a computer file. A batch program that can be run at a later time will read this filed data and with it carry out a stress analysis of the disc using finite element techniques. Experience has shown that this method of entering data to the computer is very easy to use but, most important, design times can be reduced. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N71-12513* Radio Corp. of America, New York.
RADIATION RESISTANT SILICON SEMICONDUCTOR DEVICES Patent
Joseph J. Wysocki, inventor (to NASA) Issued 20 Jan. 1970 (Filed 17 May 1967) 4 p Cl. 148-188; Int. Cl. H01l7/44 Sponsored by NASA
(NASA-Case-XGC-07801; US-Patent-3,490,965; US-Patent-Appl-SN-640452) Avail: US Patent Office CSCL 09A

The process includes forming a p-n junction in a high-resistivity, floating-zone purified n-type silicon body having a low oxygen content and a low donor impurity concentration. Lithium is then added by diffusion doping at temperatures as low as 300 to 500 C, and the product is further heated if necessary to diffuse the lithium through the n region of the product. The process improves the radiation resistance of such n-type semiconductors. R.B.

N71-12514* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SCR BLOCKING PULSE GATE AMPLIFIER Patent
Eugene L. Kelsey and Hugh M. Holt, inventors (to NASA) Issued 20 Jan. 1970 (Filed 17 Apr. 1967) 4 p Cl. 307-252; Int. Cl. H03k17/02
(NASA-Case-XLA-07497; US-Patent-3,491,255; US-Patent-Appl-SN-631848) Avail: US Patent Office CSCL 09E

A circuit is described for gating a silicon-controlled rectifier (SCR) which decreases the likelihood that a negative transient voltage on the cathode of the SCR will cause unwanted gating. When an input gating pulse is applied to the circuit, two simultaneous pulses are produced across the secondaries of two transformers. One of the two pulses is applied to a second SCR to gate it and the other pulse is applied through the gated second SCR to the first SCR to gate it. Any negative voltage on the cathode of the first SCR does not gate it until after the second SCR has been gated. R.B.

N71-12515* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MAGNETIC COUNTER Patent
Richard R. Hayden, inventor (to NASA) Issued 20 Oct. 1970 (Filed 19 Sep. 1967) 9 p Cl. 340-174; Int. Cl. G11c11/08 19/00 Int. Cl. H03k23/10 Sponsored by NASA
(NASA-Case-XNP-08836; US-Patent-3,535,702; US-Patent-Appl-SN-668968) Avail: US Patent Office CSCL 09E

An electronic counter circuit is described which has multiple divider stages, each of which includes a transfluxor passing through

four conditions of magnetization for every two transfer pulses received from the preceding stage. Each transfer pulse has positive and negative portions. Each stage also includes a transistor for generating transfer pulses for the next stage, the transistor being turned on when the transfluxor passes from one of its four stages to the next. R.B.

N71-12516* Hughes Aircraft Co., Los Angeles, Calif.
BOOTSTRAP UNLOADER Patent
Harold J. Pfiffner, inventor (to NASA) Issued 20 Oct. 1970 (Filed 17 Jan. 1968) 5 p Cl. 307-243; Int. Cl. Ho3k17/00 Sponsored by NASA
(NASA-Case-XNP-09768; US-Patent-2,535,554; US-Patent-Appl-SN-698629) Avail: US Patent Office CSCL 09E

Unloading circuits are discussed for sampling transducer voltage sources without drawing current. The circuits comprise a separate processing switch for each transducer, a differential amplifier with one input connected to the outputs of all of the processing switches, another input connected to an equivalent circuit which draws as much current as any one of the processing switches when it is on, and feedback loops connecting the differential amplifier output to its two inputs. E.C.

N71-12517* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GYRATOR TYPE CIRCUIT Patent
Gordon J. Deboo, inventor (to NASA) Issued 3 Feb. 1970 (Filed 5 Mar. 1968) 6 p Cl. 333-80; Int. Cl. H01p1/24, 1/32
(NASA-Case-XAC-10608-1; US-Patent-3,493,901; US-Patent-Appl-SN-710561) Avail: US Patent Office CSCL 09E

A gyrator circuit using operational amplifiers to replace an ungrounded inductor is described. By combining two separate gyrator circuits which have two operational amplifiers, only three operational amplifiers are required to produce the function and characteristics of an ungrounded inductor. Circuit diagrams and mathematical models of the proposed device are presented. P.N.F.

N71-12518* Hughes Aircraft Co., Culver City, Calif.
DEFLECTIVE ROD SWITCH WITH ELASTIC SUPPORT AND SEALING MEANS Patent
Burnham Nelson, inventor (to NASA) Issued 6 Jan. 1970 (Filed 21 Dec. 1967) 5 p Cl. 200-61.42; Int. Cl. H01h3/16 Sponsored by NASA
(NASA-Case-XNP-09808; US-Patent-3,488,461; US-Patent-Appl-SN-692471) Avail: US Patent Office CSCL 09E

An hermetically sealed electric switch which can be closed by forces applied from a wide variety of directions is described. The switch comprises a tube connected to one electrical terminal, a flexible rod projecting axially through the tube connected to the other electrical terminal, and a contact button fixed to the flexible rod near the center of the tube for making contact between the tube rod. Forces applied from any direction to the projecting rod cause it to bend, thereby moving the contact button against the inside of the tube and establishing electrical contact between the tube and the rod. P.N.F.

N71-12519* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PULSE AMPLITUDE AND WIDTH DETECTOR Patent
Murrel D. Slayden and Hugh W. Staley, inventors (to NASA) Issued 20 Oct. 1970 (Filed 28 Jul. 1967) 7 p Cl. 328-110; Int. Cl. H03k5/20
(NASA-Case-XMF-06519; US-Patent-3,535,644; US-Patent-Appl-SN-65692) Avail: US Patent Office CSCL 09E

An electrical testing apparatus is described for evaluating the amplitude and width of an electrical transient pulse to determine whether the pulse exceeds predetermined tolerance limits. The apparatus includes: (1) a phase splitter for applying the pulse in opposite polarity to a first and second trigger circuit having threshold levels adjustable to amplitudes of the same polarity, (2) an OR gate applying the output of the trigger circuit whose threshold is exceeded to a width generator for activating a gate generator a predetermined time after the threshold level of the first or second trigger circuit is exceeded, and (3) an AND gate for passing the output of the OR gate during the time that the gate generator is activated. E.C.

N71-12520* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATIONAL INTEGRATOR Patent
Erno B. Lutz, inventor (to NASA) Issued 20 Oct. 1970 (Filed 19 Dec. 1967) 7 p Cl. 307-229; Int. Cl. G06g7/18 Sponsored by NASA
(NASA-Case-NPO;10230; US-Patent-3,535,547; US-Patent-Appl-SN-691735) Avail: US Patent Office CSCL 09A

A simple solid state operational integrator is described. Operable at frequencies up to and including those in the VHF range, the integrator contains a current summing circuit to which an input current related to an input signal is supplied through an input resistor, and a feedback current is supplied through an input resistor, and a feedback current is supplied through a resistor. The summing circuit output is a transistor connected in a common-base configuration to a parallel resistive-capacitive combination and an output terminal. The feedback resistor is isolated from the capacitor by an emitter follower. The output signal is a true time integral of the input signal. E.C.

N71-12521* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ULTRAVIOLET RESONANCE LAMP Patent
Arnold M. Bass, inventor (to NASA) Issued 3 Feb. 1970 (Filed 1 Nov. 1967) 4 p Cl. 313-110; Int. Cl. H01j5/16, 61/40
(NASA-Case-ARC-10030; US-Patent-3,493,805; US-Patent-Appl-SN-679885) Avail: US Patent Office CSCL 09E

An ultraviolet resonance lamp to produce atomic resonance lines of relatively high intensity is described. The tube contains an ultraviolet wave-permeable window through which radiation from the excited gas is transmitted. Decomposition and/or vaporization of the window seal is prevented by means of a chamber which surrounds the tube adjacent to the window. The design will eliminate the impurity atomic emission lines produced by gases which result from decomposition of the sealing composition in conventional tubes. P.N.F.

N71-12522# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
BIPHASE MODULATOR Final Technical Report, May–Jul. 1970
H. Malone and R. Moore 4 Sep. 1970 25 p
(Contract N00123-70-C-1701)
(AD-713003; Rept-3922-F-1) Avail: NTIS CSCL 9/5

The report describes work on a biphase modulator fabricated using microwave integrated circuit techniques. Primary requirements on the unit were switching times of less than 5 nanoseconds. The goals were successfully achieved using PIN diodes in a microstrip RF circuit. Author (TAB)

N71-12523# Coast Guard, Baltimore, Md. Field Testing and Development Center.
UNION CARBIDE 12-VOLT SWITCHING DEVICE Final Report
W. E. Newland 9 Oct. 1970 30 p
(AD-712584; Rept-520) Avail: NTIS CSCL 9/1

A 12-volt DC switching device was developed for use in switching the load to a standby power unit upon failure of the working unit. This report covers tests performed on a sample of these devices. These tests include measurements of current drains imposed by the device, determination of the voltage differential

between standby and working power units for switching to occur, determination of whether the switching is complete or if there is load sharing, the effects of shorting various leads, and some brief dynamic load tests. Author (TAB)

N71-12524# Naval Underwater Systems Center, New London, Conn. Sonal Transducer Center.

THE OPEN-CIRCUIT SENSITIVITY OF RADIALLY POLARIZED FERROELECTRIC CERAMIC CYLINDERS

Charles L. Le Blanc 18 Sep. 1970 28 p refs

(AD-712766; NUSC-NL-4001; Rept-1088) Avail: NTIS CSCL 9/1

The open-circuit sensitivity of radially polarized ferroelectric ceramic cylinders is derived by treating the ceramic as an anisotropic material. The analysis demonstrates that if the anisotropic properties of the materials employed in the design of cylindrical hydrophone elements are considered, the resulting sensitivities are not significantly different from those derived by Langevin, who considered only stress distributions that obey isotropic criteria. Graphs of the open-circuit sensitivity versus the ratio of wall thickness to outside diameter are presented for the two dissimilar approaches that define the regions over which the differences may be neglected. Author (TAB)

N71-12525# Stanford Research Inst., Menlo Park, Calif.

INQUIRY INTO THE ECONOMIC EFFECTS OF AIR POLLUTION ON ELECTRICAL CONTACTS Final Report

Robert C. Robbins Apr. 1970 101 p refs

(Contract PH 22-68-35)

(PB-192478; APTD-67) Avail: NTIS CSCL 09A

Prevention of contact failure in low voltage contacts is the largest problem. Millions of low voltage contacts are used in computer and instrumentation circuits, and some provision must be made to ensure their reliable and continued operation. The sulfur gases are primarily responsible for the deleterious effect of air pollution on these contacts. More money is spent in the protection of low voltages contacts against the effects of sulfur gases than in all the other contact problem areas combined. Protection of low voltage contacts against sulfur gases takes two forms: the use of air conditioning and air purification equipment: the other kind of protection of contacts against sulfur gases is precious metal plating. The cost relating to failure of electrical devices caused by air pollution for 1968 is estimated to be about $64 million in the United States. Reducing current air pollution by 50 percent would have little effect on air pollution costs related to electrical devices, because any reduced level of recognized air pollution would still require that measures taken to combat air pollution effects be continued at the same level of effort. Author (USGRDR)

N71-12526* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

ELECTRICAL LOAD PROTECTION DEVICE Patent

Lewis O. Casey, inventor (to NASA) Issued 3 Jun. 1969 (Filed 19 Sep. 1969) 5 p Cl. 317-31; Int. Cl. H02h3/28; Int. Cl. H01h85/14

(NASA-Case-MSC-12135-1; US-Patent-3,448,341; US-Patent-Appl-SN-761404) Avail: US Patent Office CSCL 09E

An in-line electrical load protection device is described. The device is a hollow, hermetically sealed, electrically non-conductive body filled with an inert gas, an electrically conductive fuse link, and a cathode element. When the source voltage exceeds a predetermined value, current flows from the fuse link to the cathode through the gas. When this current, in combination with the load current exceeds the predetermined amount, the fuse link melts thus opening the circuit and preventing damage. P.N.F.

N71-12527# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.

SYNTHESIS TECHNIQUES FOR ACTIVE RC FILTERS USING OPERATIONAL AMPLIFIERS

Hernani Mationg Jover (M.S. Thesis) (Philippine Navy) Jun. 1970 199 p refs

(AD-712466) Avail: NTIS CSCL 9/5

The stimulus provided by the trend towards microminiaturization has generated considerable interest in active RC filters utilizing operational amplifiers. A comprehensive and unified presentation of the many different techniques to synthesize such filters is made along the lines of modern filter theory in the thesis. Author (TAB)

N71-12528# Mitre Corp., Bedford, Mass.

DETERMINATION OF RECEIVER DYNAMIC RANGE BY MEANS OF INPUT INTERCEPT POINTS

Paul Krenitsky ESD Aug. 1970 49 p refs

(Contract F19628-68-C-0365)

(AD-712410; MTR-1783; ESD-TR-70-293) Avail: NTIS CSCL 9/6

An investigation was conducted to find a practical method of performing an input intercept point test for the CORTS program. This test was applied to several current models of telemetry receivers and the results are presented. Additional types of receiver tests were conducted in order to work out standard test procedures for the Telemetry Working Group (TWG), Receiver/Transmitter Committee of IRIG. Author (TAB)

N71-12529# Illinois Univ., Urbana. Dept. of Computer Science.

SOME REMARKS ON ELECTROLYTIC TRANSISTORS

W. J. Poppelbaum Apr. 1970 6 p

(TID-25456) Avail: NTIS

A linear theory of an electrolytic model of transistors is presented. Based on a modified form of the Shockly equations, transport equations, and hypotheses concerning the electrolytic transistor, it is shown that there is a strong resemblance between the characteristics of the electrolytic transistor and those of the standard bipolar version. Similar forms of the Nernst equations and carrier injector equations do not lead to the same equation, since there is no spontaneous recombination in the body of the electrolyte. F.O.S.

N71-12530# Norges Tekniske Hoegskole, Trondheim, Inst. for Transmisjonsteknikk.

ACTIVE FILTERS FOR TIME DIVISION MULTIPLEXING SPEECH TRANSMISSION [AKTIVE MODEMFILTRE FOR TDM-TALETRANSMISJON]

P. Eikeset Mar. 1969 55 p refs In NORWEGIAN; ENGLISH summary Sponsored by Roy. Norweg. Council for Sci. and Ind. Res.

(ELAB-TR-125) Avail: NTIS

A study of the various filter types used in time division multiplexing (TDM) speech transmission, especially active filters, is made. Relevant transmission systems and principles are discussed and a complete survey of specifications and requirements for the various transmission systems is made. Unilateral active filters have been developed for 4-line systems in which transmission takes place either through direct filtration on the receiving side of the samples in the pulse amplitude modulated (PAM) signal, or by storing the sample value prior to the filtration (sample-and-hold method). Author (ESRO)

N71-12531# Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse (France).

PHYSICAL CHARACTERIZATION OF ELEMENTARY MOS TRANSISTOR LOGIC CIRCUITS [CARACTERISATION PHYSIQUE DES CIRCUITS LOGIQUES ELEMENTAIRES A TRANSISTORS MOS]

Michel Salviac (Ph.D. Thesis--Toulouse Univ.) Toulouse Univ. Jun. 1969 213 p refs In FRENCH

Avail: NTIS

The characteristics of metal oxide semiconductor transistors used in inverters are reviewed with special emphasis on the input-substrate polarization. The influences of the technological and electrical parameters are discussed with the aim of obtaining the best characteristics. The dynamic capacity of MOS transistors is analyzed theoretically and the electric charge variations on the grid as functions of the polarization voltages are discussed. ESRO

N71-12532# Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse (France).
IONIZING RADIATION DAMAGE IN MOS TRANSISTORS [DEGRADATIONS INDUITES DANS LES TRANSISTORS M.O.S. PAR LES RAYONNEMENTS IONISANTS]
Augustin Martinez (Ph.D. Thesis - Toulouse Univ.) Toulouse Univ. 1969 181 p refs In FRENCH
Avail: NTIS

The properties of the positive space charge induced in the oxide by ionizing radiations and its effect on the electric properties are discussed. A model for the oxide traps, photoconduction in the silica, and electrode photoinjection is also discussed. The effects of high temperature on the electrical properties of previously irradiated MOS transistors are also described. ESRO

N71-12533*# General Electric Co., Binghamton, N.Y. Avionic Controls Dept.
BRUSHLESS dc MOTOR Interim Report
B. H. Hertzendorf Nov. 1970 31 p refs
(Contract NAS8-26213)
NASA-CR-102942) Avail: NTIS CSCL 09C

The motors have split windings which can be connected in either a full-winding or a 1/4-winding configuration. The motors provide up to 5.0 ft-lbs output torque at speeds up to 435 rpm with the full-winding. With the 1/4-winding the motors will operate at 1.25 ft-lbs and at speeds up to 1740 rpm. The motor design was optimized for operation in the 1/4-winding condition. A summary of the brushless dc motor specifications, along with the actual test results are presented. The test results shown are the average values for the two motors. Test data for each motor are also given. Author

N71-12534 Case Western Reserve Univ., Cleveland, Ohio.
TRANSIENTS IN DISCONTINUOUS CONTROL SYSTEMS
David Edwin Limbert (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-4953

The transient response of single loop systems with quantized error signals is discussed. The transients produced for step inputs are investigated for both nonoscillatory and oscillatory systems. Design algorithms are developed for designing three level quantizers for minimum overshoot response. The relationship between minimum overshoot response and system stability is also studied. Dissert. Abstr.

N71-12535# Utah Univ., Salt Lake City. Dept. of Physics.
SELF-SWITCHING Q-DAMPING CIRCUIT FOR REDUCING TRANSMITTER RINGDOWN TIME IN HIGH POWER PULSE NMR
Gary L. Samuelson and David C. Ailion [1969] 10 p
(Grant NSF GP-17412)
Avail: Issuing Activity

A circuit is described for reducing the transmitter ringdown time and thereby improving the recovery time in pulse NMR experiments. The circuit uses only solid state devices and requires no external switching. For transmitter voltages less than .5 V peak to peak the effective resistance in parallel with the transmitter coil in a crossed-coil spectrometer is only 6 ohms, whereas for larger voltages the shunting resistance is of the order of 1K to 2K. This circuit has the effect of significantly squaring the envelope of an rf pulse. It has the extra advantage of suppressing noise generated by the transmitter during the time interval between pulses. Author

N71-12536# Utah Univ., Salt Lake City. Dept. of Physics.
COUPLING NETWORK FOR HIGH POWER PULSE NMR
G. L. Samuelson and D. C. Ailion [1969] 12 p refs
(Grant NSF GP-7894)
Avail: Issuing Activity

A description is given of simple, easily adjustable network appropriate for coupling a high power (1 KW) pulsed envelope of rf of up to 10 seconds pulse duration to a moderately high Q sample coil, such that the ringdown time is approximately 1 microsec but the coil heating is small. The network uses pi-matching along with series rather than parallel tuning of the sample coil, thus insuring that the processes of tuning and matching are independent. The equations determining the values of the circuit parameters are worked out. Author

N71-12537*# Scripta Technica, Inc., Washington, D.C.
A COMPACT TRANSISTORIZED PULSE UNIT [MALOGABARITNAYA IMPUL'SNAYA PRISTAVKA NA TRANZISTORAKH]
I. D. Reilyan NASA Dec. 1970 4 p Transl. into ENGLISH from Byul. Stantsii Opticheskogo Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 53, issue no. 1, 1969 p 36 - 37
(Contract NASw-2036)
(NASA-TT-F-13351) Avail: NTIS CSCL 09E

The circuit of a miniature transistorized pulse unit which is used in the Kishinev Satellite Tracking Station is described. Author

N71-12538# Varian Associates, Palo Alto, Calif.
STABILIZED AIR PUMPING WITH DIODE TYPE GETTER-ION PUMPS
Robert L. Jepsen, Arthur B. Francis, Sherman L. Rutherford, and Burdell E. Kietzmann [1969] 25 p refs
Avail: Issuing Activity

It was found previously that diode type getter-ion pumps exhibit spontaneous periodic pressure fluctuations (argon instability) under extreme air leak conditions due to their relatively low pumping speed for argon. The argon pumping speed was increased by a factor of five through modifications of the geometry of the pump, although the diode structure was retained. Pumps employing these modified geometries were tested on air leaks resulting in various pressures up to 5×0.00005 mm Hg, and have given no indication of argon instability for the equivalent of over 2000 hours at 1×0.00005 mm Hg. Author

N71-12539* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
METHOD AND MEANS FOR AN IMPROVED ELECTRON BEAM SCANNING SYSTEM Patent
Edwin H. Hilborn, inventor (to NASA) Issued 20 Oct. 1970 (Filed 10 Apr. 1968) 8 p Cl. 178-7.7; Int. Cl. H01j29/70; Int. Cl. H04n3/16
(NASA-Case-ERC-10552; US-Patent-3,535,446; US-Patent-Appl-SM-720125) Avail: US Patent Office CSCL 20G

An electron beam scanning system is described for raster scanning systems such as television and character recognition devices. The system provides a high definition image within the conventional television bandwidth and reduces the power requirements for video signal transmission. By displacing the raster by a fraction of a raster line height on each successive frame, a new phase relationship is utilized at the start of each frame; thus correct positional relationships are maintained at both the camera and motitor. Schematics of the modified scan and circuitry are included. J.M.

N71-12540* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STARTING CIRCUIT FOR VAPOR LAMPS AND THE LIKE Patent
John E. Guisinger, inventor (to NASA) Issued 6 Sep. 1966 (Filed 1 Oct. 1963) 5 p Cl. 315-160 Sponsored by NASA
(NASA-Case-XNP-01058; US-Patent-3,271,620;

US-Patent-Appl-SN-313136) Avail: US Patent Office CSCL 09A

A starting circuit is described for starting and maintaining an arc in vapor lamps. It is comprised of an amplifier including an output terminal and a control input terminal; a high voltage direct current source; parallel conductors for generating an oscillating signal; a capacitor; a vacuum tube with a cathode, control grid, and anode; switches and connections; and a low voltage direct current source. The lamp is positioned at the point of maximum voltage and minimum current by placing it one quarter wavelength from a point of maximum current and minimum voltage. Diagrams of the power supply and vapor lamp starting circuit are included. J.M.

N71-12632# Westinghouse Electric Corp., Baltimore, Md.
SPECIAL PURPOSE APPLICATIONS
George Shapiro /.) AGARD Large Scale Integration in Microelectron. Oct. 1970 11 p Supported in part by Fairchild Semiconductor Corp., Intel Corp., Motorola Semiconductor, PROD, RCA Electron. Components, and Tex. Instr. Inc. (See N71-12626 03-10) Avail: NTIS

The LSI devices and techniques available to the designer of electronics systems are described. The problems and methods of interconnection are discussed briefly. Factors to be considered in the system design are included. Specific applications such as digital differential analyzers, moving target indication, radar beam sharpening, and spectral analysis are covered. Limitations of current systems and possible directions for future special processor organizations are indicated. Finally, a brief indication of application of LSI technology to microwave circuits is given. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N71-12542# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS REVIEW, VOLUME 3, NO.12, 1969 INDEE
Wade B. Holland, ed. Dec. 1969 26 p refs
(Contract F44620-67-C-0045; Proj. Rand)
(AD-709872; RM-6000/12-PR) Avail: NTIS CSCL 9/2

The report is a set of indeees to the 1969 issues of Soviet Cybernetics Review, and bibliography with abstracts of 18 other Rand publications in the field of Soviet cybernetics. There are detailed indexes by subjects, personalities (including authors, persons written about and persons pictured), organizations, and hardware/software. Author (TAB)

N71-12543# Technische Hochschule Stuttgart (West Germany). Inst. fuer Halbleitertechnik.
CROSS MODULATION IN FIELD EFFECT TRANSISTORS [KREUZMODULATION IN FELDEFFEKTTRANSISTOREN]
Johannes M. Gerstlauer (Ph.D. Thesis) 1970 89 p refs In GERMAN
Avail: NTIS

It is shown that the cross modulation behavior of barrier layer field effect transistors may be determined from the manufacturer's data for low frequencies with nonlinear transconductance (in source connection). As the Shockley model is not appropriate for this purpose the transconductance is determined as a function of the working point from the channel conductance for zero drain-source voltage. ESRO

N71-12544# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS REVIEW, VOLUME 4, NO. 6
Wade B. Holland, ed. Jun. 1970 63 p refs
(Contract F44620-67-C-0045; Proj. Rand)
(AD-709873; RM-6200/6-PR) Avail: NTIS CSCL 9/2

Contents: Survey of the first all-union conference on programming; Collective use computer systems; A Tsar 3 for the computer industry; Programmed instruction and teaching machines in the USSR; The central economic mathematics institute; Armenia: Uniting computer design and production; A 500-nanosec memory for BESM-6; Neurobionics: An overview; Training programming teachers; Automated control systems in the Belorussian republic; French journalists examine BESM-6 at Serpukhov; Cybernetics in the scientific revolution; The plight of an inventor. TAB

N71-12545# Advisory Group for Aerospace Research and Development, Paris (France).
STANDARDIZATION OF THE PRINCIPAL ELECTROMAGNETIC SYMBOLS [NORMALISATION DES PRINCIPAUX SYMBOLES D'ELECTROMAGNETISME]
Pierre Halley Dec. 1970 27 p In ENGLISH and FRENCH
(AGARD-R-576-70) Avail: NTIS

Authors dealing with electromagnetism encounter difficulties of notation for quantities or dimensionless numbers related to this field. As a matter of fact, the number of small and capital letters in the Greek and Roman alphabets is insufficient to cover the large variety of problems arising in this area without avoiding successive uses of the same symbol in several different meanings. In an attempt to clarify this situation, the AGARD Electromagnetic Wave Propagation Panel recommends authors who participate in its meetings to adhere as closely as possible to the signs, notations, symbols and units specified in the present document. Author

N71-12546*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
GENERALIZED PULSE MODULATED FEEDBACK SYSTEM: NORMS, GAINS LIPSCHITZ CONSTANTS, AND STABILITY
R. A. Skoog and G. L. Blankenship Oct. 1969 42 p refs
(Grant NGR-22-009-124)
(NASA-TM-X-66501; PM-93) Avail: NTIS CSCL 09C

Two broad classes of pulse elements are defined and the analysis is conducted in terms of those generalized modulators. The goal of this generalization is the development of a unified approach to the study of pulse modulated systems. The classes as defined include all the pulse elements commonly studied and the gain calculations and stability conditions specialize immediately to these elements. The two classes are distinguished by the means of measuring the input. In Type 1 are included those pulse modulators that sample the input. Type 2 includes those using a linear functional to measure the input. Because the size of the output pulses are fixed the latter class contains no elements that are continuous on any normed linear space. Author

N71-12547# Tennessee Univ., Tullahoma. Space Inst.
SIMULATION OF THE LAPLACE TRANSFORM BY MEANS OF DC POTENTIAL IN SEMICONDUCTOR MATERIALS, Final Report
E. C. Huebschumann and C. W. Pender Sep. 1970 60 p refs
(Contract DAAH01-69-C-1735)
(AD-713021) Avail: NTIS CSCL 9/5

Research has been conducted into techniques for mechanically representing or simulating selected transfer functions. The technique used is based on the logarithmic potential or an electrical source and sink on a two-dimensional conducting sheet. Various semiconductor materials have been investigated and a suitable material has been chosen for use in a transfer function simulation device. Several materials were considered and are still under consideration for an

improved device. The semiconductor material used in the device described in this report was chosen due to availability, performance predictability, and flexibility. Experiments with several devices have resulted in a notion of an optimum size for the conducting plane in the device. Investigation has revealed information concerning size relative to uniformity of conducting plane, contact difficulties, and density of pickoff contacts. Author (TAB)

N71-12548# Southern Methodist Univ., Dallas, Tex. Information and Control Sciences Center.

OPTIMALLY INSENSITIVE ACTIVE CIRCUIT SYNTHESIS OF SECOND ORDER TRANSFER FUNCTIONS

Brian D. O. Anderson Feb. 1970 27 p refs
(Contract F44620-68-C-0023)
(AD-712414; AFOSR-70-1727TR) Avail: NTIS CSCL 9/5

Using state variable techniques, the synthesis is considered of a second order transfer function using operational amplifiers, resistors and integrators. The circuit is found which minimizes the maximum of the absolute value of the sensitivity of either the w sub 0 or Q of the transfer function to any component variation. An improvement by a factor of two is noted over a circuit discussed previously. Author (TAB)

N71-12549# Aeronautical Research Labs., Melbourne (Australia).

THICKNESS MEASUREMENTS ON PLATES USING THE EDDY CURRENT TECHNIQUE

I. G. Scott Jan. 1970 36 p refs
(ARL/Met-80) Avail: NTIS

A technique was developed by means of which estimates can be made of the effects of interfering variables, and optimum test conditions can be chosen, for tests on conducting plates. A generally theoretical approach is used, coupled with the experimental confirmation of specific applications. Author

N71-12550# Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse (France).

STUDY AND CONSTRUCTION OF A FUNCTION MULTIPLIER USING LOGARITHMIC RESPONSE AMPLIFIERS [ETUDE ET REALISATION D'UN MULTIPLIEUR DE FONCTIONS UTILISANT DES AMPLIFICATEURS A REPONSE LOGARITHMIQUE]

Fernand Gouiffes (Ph.D. Thesis—Toulouse Univ.) Toulouse Univ. Jun. 1969 180 p refs In FRENCH
Avail: NTIS

In order to extend the use of analog computers from linear differential equations to nonlinear ones suitable multipliers and function generators were investigated. Nonlinear logarithmic amplifiers are discussed and their use as function generators is described. A nonlinear logarithmic multiplier for single quadrant operation and its errors are analyzed in detail. A generalized logarithmic multiplier for the product of x to the k power and y to the h power function in four quadrants is also described. ESRO

N71-12551 California Inst. of Tech., Pasadena.

RADIATION FROM AN ANTENNA ENTERING THE MARTIAN ATMOSPHERE

John Dennis Norgard (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-1418

The interaction between the ionized wake of a capsule entering the Martian atmosphere and the circularly polarized radiation emitted by an antenna located on the aft part of the capsule is theoretically investigated. A simplified mathematical model of the atmosphere of Mars, the entry-trajectory of the capsule, and the flow field surrounding the capsule are used in the analysis. The far wake of the capsule is approximated by a cylindrically stratified plasma shell consisting of n plasma regions. The plasma in each region is assumed to be homogeneous, anisotropic, conducting, and moving at a uniform velocity relative to the antenna. Integral expressions for the cylindrical components of the field vectors are obtained by a rigorous relativistic formulation of the problem, and are evaluated using the techniques of asymptotic expansions to yield the radiation patterns of the antenna. Dissert. Abstr.

N71-12552# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

ON THE DESIGN OF P-I-D CONTROLLERS USING OPTIMAL LINEAR REGULATOR THEORY

Michael Athans Jul. 1970 17 p refs
(Grants NGL-22-009-124; AF-AFOSR-1724-69)
(NASA-CR-111516; AD-710300; ESL-P-432; AFOSR-70-2098 TR) Avail: NTIS CSCL 12A

The purpose of this note is, using a very simple example, to indicate the proper formulation of a class of tracking problems, so that the solution by means of optimal linear regulator theory leads to a proportional-integral-derivative P-I-D type of controller. This controller has the property of eliminating steady-state errors and leads to an insensitive design. Author (TAB)

N71-12553# Signals Research and Development Establishment, Christchurch (England).

AN ASSESSMENT OF THE LONG TERM CAPACITOR REQUIREMENTS FOR STATIC POWER CONVERSION EQUIPMENTS

C. E. Mugford July 1969 20 p Revised
(SRDE-68007) Avail: NTIS

The equipment designer's requirements for capacitors in the next decade are discussed in terms of the trends in conversion towards higher powers and smaller sizes. The main topics considered are commutation, filters, and the environmental conditions of capacitors. Author

N71-12554* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MATCHED THERMISTORS FOR MICROWAVE POWER METERS Patent

Charles T. Stelzried, Donald L. Mullen, and Donald A. Oltmans, inventors (to NASA) Issued 6 Oct. 1970 (Filed 12 Feb. 1968) 7 p Cl. 324-95; Int. Cl. G01r21/04; Int. Cl. H01c7/04 Sponsored by NASA
(NASA-Case-NPO-10348; US-Patent-3,532,979; US-Patent-Appl-SN-704668) Avail: US Patent Office CSCL 14B

A microwave power meter with compensation for temperature changes is described. It has a pair of thermistors on a mounting block, one measuring microwave power and the other compensating for temperature changes of the mounting block. The compensating thermistor is matched to the other by a coating of black paint to increase heat dissipation by conduction and radiation. A fine paint mist is applied, for accurate coating, by locating the themistor between an air suction device and a paint sprayer. F.O.S.

N71-12555*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

A FREQUENCY DOMAIN APPROACH TO OPTIMAL CONTROL

William A. Wolovich Dec. 1968 32 p refs
(NASA-TM-X-66500; PM-76) Avail: NTIS CSCL 09C

Linear optimal control theory is gradually becoming an accepted technique for the design of multivariable control systems in a wide variety of applications. For the most part, optimal control theory has evolved as a time domain analysis and synthesis procedure. Some results, however, have been obtained using the frequency domain (transfer function) approach. As demonstrated in the paper, optimal control problems can be solved in the frequency domain using a new representation for the transfer matrix. These solutions offer certain advantages over the time domain solution, specifically from the computational viewpoint. Author

N71-12581# General Electric Co., Philadelphia, Pa.
ELECTROMAGNETIC INTERFERENCE CONTROL IN SPACECRAFT DESIGN
M. Berkowitz *In* ESRO Proc. of the 6th ESRO Summer School, Vol. 11: Space Power Systems: Power Conditioning and Control Nov. 1969 p 123 - 141 refs (See N71-12576 03-03)
Avail: NTIS

An introduction is made to the methods of achieving electromagnetic compatibility (EMC) and electromagnetic interference (EMI) control in spacecraft. The importance of implementation of an interference control program in the early planning and design stages of an aerospace system is stressed. The points to be considered are illustrated by a description of the NASA Nimbus weather satellite. A short account of interference prediction analysis is then given. Some of the more important techniques for the suppression of interference are discussed, followed by a brief sketch of how interference and susceptibility tests are made
Author (ESRO)

N71-12626# Advisory Group for Aerospace Research and Development, Paris (France).
LARGE SCALE INTEGRATION IN MICROELECTRONICS
Oct. 1970 115 p refs Presented in London and Duesseldorf, 6 10 Jul. 1970; Sponsored by AGARD Its Lecture Ser. No. 40 (AGARD-LS-40-70) Avail: NTIS

CONTENTS:

1. EVOLUTION OF LSI J. W. Lathrop (Clemson Univ.) 11 p refs (See N71-12627 03-10)

2. COMPARISON OF MOS AND BIPOLAR LSI TECHNOLOGY W. Engbert (AEG-Telefunken, Heilbronn, West Germany) 10 p refs (See N71-12628 03-10)

3. COMPUTER AIDED DESIGN IN THE REALISATION OF LARGE SCALE INTEGRATION SYSTEMS WITH PARTICULAR REFERENCE TO MOS S. Forte (Marconi-Elliott Microelectronics, Ltd.) 10 p (See N71-12629 03-10)

4. THE IMPACT OF LSI (LARGE-SCALE INTEGRATION) ON SYSTEM PACKAGING J. H. Martin 16 p (See N71-12630 03-10)

5. APPLICATIONS OF LSI IN AIRBORNE COMPUTERS F. P. Maison (Electronique Marcel Dassault) 9 p refs (See N71-12631 03-08)

6. SPECIAL PURPOSE APPLICATIONS G. Shapiro (Westinghouse Electric Corp., Baltimore, Md. 11 p (See N71-12632 03-09)

7. LSI RELIABILITY D. C. Mueller (Texas Instruments, Inc., Houston) 23 p refs (See N71-12633 03-15)

8. ECONOMIC CONSIDERATIONS IN LSI DESIGN R. C. Foss (Microsystems International, Ltd.) 8 p refs (See N71-12634 03-10)

N71-12627# Clemson Univ., S.C. Dept. of Electrical Engineering.
EVOLUTION OF LSI
J. W. Lathrop *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 11 p refs (See N71-12626 03-10)
Avail: NTIS

The history of the integrated circuit and its development into LSI is traced. Major events influencing LSI are noted. The origin of the LSI concept is discussed. It is pointed out that LSI components may be characterized by complexity, device structure, interconnection technology, and design. Each of these characterization methods is explored in turn and terms such as MSI, chip, hybrid, standard circuits, custom circuits, and fixed interconnection pattern are defined. Present complexity trends are extrapolated to yield a prediction of the types of components available to electronic systems designers during the 1970's.
Author

N71-12628# AEG-Telefunken, Heilbronn (West Germany).
COMPARISON OF MOS AND BIPOLAR LSI-TECHNOLOGY
W. Engbert *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 10 p refs (See N71-12626 03-10)
Avail: NTIS

A flow chart of the production processes of bipolar and MOS circuits is represented in a comparative manner. The production actions are classified as to costs and possible sources of failures. Remedial measures can be taken by projection masking, described in detail. Nevertheless the costs of wiring, made discretionary to shunt incorrect areas of the slice, are very high. Techniques are picked out, which promise higher yield, more packing density, better performance of the circuits. These are ion implantation, planoxide structuration, replacement of metal gates in MOS circuits by silicon, silicon on spinel deposition.
Author

N71-12629# Marconi-Elliott Microelectronics, Ltd., Witham (England). MOS Products.
COMPUTER AIDED DESIGN IN THE REALISATION OF LARGE SCALE INTEGRATION SYSTEMS WITH PARTICULAR REFERENCE TO MOS
S. Forte *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 10 p (See N71-12626 03-10)
Avail: NTIS

The successive stages of simulation, dc and transient analysis, automatic artwork preparation (using both on-line and off-line methods) and testing are discussed with reference to the ways in which computers can reduce costs and turn-round time in the design of integrated circuits. The greater magnitude of the problems with LSI will be shown to make the extensive use of computers virtually mandatory, given the short design cycle time needed because of the custom nature of most LSI.
Author

N71-12630*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
THE IMPACT OF LSI (LARGE SCALE INTEGRATION) ON SYSTEM PACKAGING
Jacob H. Martin *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 16 p (See N71-12626 03-10)
(Contract NAS9-4065; DRS Proj. 55-23870; DRS Proj. 55-38660) (NASA-CR-111646) Copyright. Avail: NTIS CSCL 09C

The potential advantages of large-scale integration will be gained or lost by the system packaging engineer. To fully realize these advantages it is necessary to move in the direction of physically integrating the whole system. Just as the interconnection of circuits in a piece of silicon is the key to LSI, so are the various levels of interconnection in a system the key to its integration. The improved packing density brought about by the systematic application of the physical integration philosophy is quantitatively given. The way in which LSI influences the packaging of circuitry which cannot be realized in LSI form is also discussed.
Author

N71-12634# Microsystems International, Ltd., Ottawa (Ontario). Applications.
ECONOMIC CONSIDERATIONS IN LSI DESIGN
R. C. Foss *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 8 p refs (See N71-12626 03-10)
Avail: NTIS

The LSI circuits, particularly in MOS form, offer a cost-per-function which is an order of magnitude lower than conventional integrated circuits with greater savings if the special needs for LSI realization are noted. These needs are outlined and it is shown how the optimum manufacturing cost can occur at levels of integration close to the point of manufacturing impracticability. The significance of this paradox is discussed from the users viewpoint with reference to problems such as throw-away cost and development time-scales. Design approaches to LSI circuits are compared and it is concluded that the situation is essentially evolutionary rather than revolutionary.
Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N71-12663# MSA Research Corp., Evans City, Pa.
MOISTURE SEPARATOR DEVELOPMENT PROGRAM Quarterly Progress Report, Jan. - Mar. 1970
Apr. 1970 4 p
(Contract AT(45-1)-2145)
(MSAR-70-79) Avail: NTIS

Work during the period included evaluation of commercially available moisture separators, design and construction of prototype separators, and completion of literature surveys on moisture separators. NSA

N71-12664*# Firestone Tire and Rubber Co., Akron, Ohio. Defense Research Div.
DEVELOPMENT OF METEOROID SIMULATORS FOR HYPERVELOCITY IMPACT STUDIES
R. L. Woodall and E. R. Berus Oct. 1970 89 p refs
(Contract NAS9-9343)
(NASA-CR-108750) Avail: NTIS CSCL 14B

The results of studies to develop one gram aluminum meteoritic simulators using shaped charge techniques are reported. The results of the project were very encouraging. It was established that using specially designed shaped charges, jet-pellets with velocities of 8, 11 and 15 km/sec can be produced. Furthermore, the ability to control the jet-pellet length and to isolate the jet-pellet from the following debris was demonstrated. Author

N71-12665# Admiralty Underwater Weapons Establishment, Portland (England).
A DIRECTIONAL WAVE BUOY FOR OBTAINING SEA SURFACE STATISTICS UP TO 15 Hz
W. F. Baker Feb. 1970 31 p refs
(AD-712954; AUWE-TN-356/69; NSTIC-27236) Copyright. Avail: NTIS CSCL 13/10

The new wave buoy has been developed to obtain sea surface statistics over a very wide frequency range. The required wide dynamic range is obtained by the use of two measuring systems. The buoy is constrained to ride with the long wavelength components and their amplitude is measured by a vertical accelerometer. An array of resistive probes is mounted on the buoy to delineate the shorter wavelength components. In this way, measurements have been obtained over the frequency range 0.1 to 15 Hz with an effective dynamic range of 80 dB. The directional properties of the shorter wavelength components are now being studied. Author (TAB)

N71-12682# MSA Research Corp., Evans City, Pa.
MOISTURE SEPARATOR DEVELOPMENT Quarterly Progress Report, Oct. - Dec. 1969
Jan. 1970 5 p
(Contract AT(45-1)-2145)
(MSAR-70-17) Avail: NTIS

Efforts during the period were devoted to information collection, evaluation, and preliminary testing. Developmental work is reported on droplet measurement techniques, aerosol generator development, and development of moisture separator prototypes. NSA

N71-12699# MSA Research Corp., Evans City, Pa.
MOISTURE SEPARATOR DEVELOPMENT Quarterly Progress Report, Jul. - Sep. 1969
Oct. 1969 7 p
(Contract AT(45-1)-2145)
(MSAR-69-192) Avail: NTIS

Work during the period was devoted to analysis of information obtained in a literature survey on moisture separators, product surveys, test plan formulation, development of drop size measuring techniques, and development of drop size separation methods. NSA

N71-12701# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SPACE SIMULATION FOR SATELLITES AND SPACE PROBES, VOLUME 1 [WELTRAUMSIMULATION FUER SATELLITEN UND RAUMSONDEN, BAND 1]
1970 356 p refs Partly in GERMAN and partly in ENGLISH Proc. of the 8th Symp. on Space Technol., Aachen, 9 - 13 Mar. 1970; sponsored by Bundesmin. fuer Bildung und Wiss.
Avail: NTIS

CONTENTS:

1. INTRODUCTION TO THE PHYSICAL PROPERTIES OF SPACE R. H. Giese (Bochum Univ.) 34 p refs (See N71-12702 03-30)

2. THE IMPORTANCE OF THE ENVIRONMENTAL REQUIREMENTS IMPOSED ON THE SPACECRAFT MANUFACTURER H. GOELLNITZ (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich) 23 p refs (See N71-12703 03-11)

3. POSSIBILITIES FOR SIMULATION IN LABORATORIES A. Lorenz 32 p (See N71-12704 03-11)

4. VACUUM TECHNIQUES IN ASTRONAUTICS F. Flecken (Leybold-Heraeus G.m.b.H.) 28 p (See N71-12705 03-11)

5. SIMULATION OF LOW SPACE TEMPERATURES R.A. Haefer (Sulzer Bros. Ltd.) 56 p refs (See N71-12706 03-11)

6. SOLAR SIMULATION METHODS E. K. Latvala (ARO, Inc.) 44 p refs (See N71-12707 03-11)

7. PRACTICAL UTILIZATION OF SOLAR SIMULATION APPARATUS AND THE NECESSARY MEASURING TECHNIQUES A. Kalt 74 p refs (See N71-12708 03-11)

8. SIMULATION OF SPACE CORPUSCULAR RADIATION K. Wohlleben (Siemens-Schuckertwerke A.G.) 60 p refs (See N71-12709 03-11)

N71-12703# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Raumfahrt.
THE IMPORTANCE OF THE ENVIRONMENTAL REQUIREMENTS IMPOSED ON THE SPACECRAFT MANUFACTURER [DIE BEDEUTUNG DER AUS DEN UMWELTBEDINGUNGEN HERRUEHRENDEN ANFORDERUNGEN FUER DEN FLUGKOERPERHERSTELLER]
H. Goellnitz *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 1 1970 23 p refs In GERMAN (See N71-12701 03-11)
Avail: NTIS

The backgrounds are given of existing environmental tests for spacecraft, especially the full scale test for the total mission. Finally, aspects of simulation and of planning are discussed. ESRO

N71-12704# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
POSSIBILITIES FOR SIMULATION IN LABORATORIES [DIE MOEGLICHKEITEN FUER DIE SIMULATION IN LABORATORIEN]
Albert Lorenz *In its* Space Simulation for Satellites and Space Probes, Vol. 1 1970 32 p In GERMAN (See N71-12701 03-11)
Avail: NTIS

Space environmental simulation in laboratories is explained from a practical, technological, and economical point of view and the necessary test equipment is also described. ESRO

N71-12705# Leybold-Heraeus G.m.b.H., Cologne (West Germany).
VACUUM TECHNIQUES IN ASTRONAUTICS [VAKUUM-TECHNIK IN DER RAUMFAHRT]
F. Flecken *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 1 1970 28 p In GERMAN (See N71-12701 03-11)
Avail: NTIS

Based on essentially three criteria, the attainable pressure, the pumping time, and the residual gas composition, the properties of several vacuum pumps and combinations are explained. Some indications are given for the construction of vacuum chambers ESRO

N71-12706# Sulzer Bros., Ltd., Winterthur (Switzerland). Abteilung Forschung und Entwicklung.
SIMULATION OF LOW SPACE TEMPERATURES [SIMULATION DER KAELTE DES WELTRAUMES]
R. A. Haefer / DFVLR Space Simulation for Satellites and Space Probes, Vol. 1 1970 56 p refs In GERMAN (See N71-12701 03-11)
Avail: NTIS

The general conditions for the simulation of the low temperature background of space are proposed, and the realization by means of liquid nitrogen-cooled blackened walls is discussed. Error sources, and generating differences between simulated and space environments, are discussed. These have to be examined with a thermal error analysis for every separate test object ESRO

N71-12707# ARO, Inc., Arnold Air Force Station, Tenn. Aerospace Environmental Facility.
SOLAR SIMULATION METHODS
E. K.Latvala *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 1 1970 44 p refs (See N71-12701 03-11)
Avail: NTIS

Characteristics of the sun's radiation are discussed and simulation requirements and tolerances are mentioned. The basic optical elements of solar simulators are considered, and various types of solar simulation systems are described. Available artificial radiation sources are discussed and a comparison is made on their suitability for testing. Finally, a discussion is presented on typical errors produced by less than ideal simulation of solar beam irradiance, spectral match, and chamber wall effects ESRO

N71-12708# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
PRACTICAL UTILIZATION OF SOLAR SIMULATION APPARATUS AND THE NECESSARY MEASURING TECHNIQUES [DER PRAKTISCHE EINSATZ EINES SONNENSIMULATIONSGERAETES UND DIE HIERFUER NOTWENDIGE MESSTECHNIK]
A. Kalt *In its* Space Simulation for Satellites and Space Probes, Vol. 1 1970 74 p refs In GERMAN (See N71-12701 03-11)
Avail: NTIS

The practical use of solar simulation equipment is described. Special attention is paid to the measuring techniques involved in determination of the properties of the radiation generated by the solar simulator. The measurement of total radiation intensity, homogeneity of radiation intensity, spectral distribution, and parallelism of the radiation are discussed. ESRO

N71-12709# Siemens -Schuckertwerke A.G., Erlangen (West Germany). Forschungslabor.
SIMULATION OF SPACE CORPUSCULAR RADIATION [SIMULATION DER KORPUSKULARSTRAHLUNG DES WELTRAUMS]
K. Wohlleben *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 1 1970 60 p refs In GERMAN (See N71-12701 03-11)
Avail: NTIS

It is shown that for spaceflight in the magnetosphere and in interplanetary space the greatest amount of corpuscular radiation is produced by Van Allen radiation and solar cosmic rays. Due to sensitivity of onboard semiconductor equipment to irradiation, a test irradiation with electrons, protons, gamma rays, and fast neutrons is necessary. Methods for testing are given. ESRO

N71-12710# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SPACE SIMULATION FOR SATELLITES AND SPACE PROBES, VOLUME 2 [WELTRAUMSIMULATION FUER SATELLITEN UND RAUMSONDEN, BAND 2]
1970 283 p refs In GERMAN Proc. of the 8th Symp. on Space Technol., Aachen, 9–13 Mar. 1970; sponsored by Bundesmin. fuer Bildung und Wiss.
Avail: NTIS

CONTENTS:

1. SIMULATION OF MAGNETIC MAGNITUDES AND MEASUREMENT OF SPACECRAFT P. Hertz (Industrieanlagen-Betriebsges. m.b.H.) 21 p refs (See N71-12711 03-11)

2. MOTION SIMULATORS FOR SPACE SIMULATION TESTS, PARTICULARLY THE AZUR SATELLITE SIMULATOR E. Leschonsky (Domier-Werke G.m.b.H., Friedrichshafen, West Ger.) 54 p refs (See N71-12712 03-11)

3. THERMAL VACUUM FACILITIES FOR SPACECRAFT TESTING W. Hallmann 28 p refs (See N71-12713 03-11)

4. MEASURING TECHNIQUES: DATA ACQUISITION AND PROCESSING OF TEST OBJECTS IN SIMULATION CHAMBERS K. Kramp 46 p refs (See N71-12714 03-11)

5. SIMULATION FACILITIES FOR SATELLITE VIBRATION TESTS E. Koppe (Industrieanlagen-Betriebsges. m.b.H.) 18 p refs (See N71-12715 03-11)

6. DIFFERENT STAGES DURING ENVIRONMENTAL TESTS OF SATELLITES W. Fueting (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich) 18 p refs (See N71-12716 03-11)

7. SPACE ENVIRONMENT SIMULATION AND THERMAL VACUUM TESTS P. Kleber 18 p (See N71-12717 03-11)

8. ANALYSIS OF DIFFERENCE BETWEEN SPACE AND SIMULATED THERMAL CONDITIONS W. Hallmann 78 p refs (See N71-12718 03-11)

N71-12711# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
SIMULATION OF MAGNETIC MAGNITUDES AND MEASUREMENT OF SPACECRAFT [SIMULATION MAGNETISCHER GROESSEN UND MESSUNG AN FLUGKOERPERN]
P. Hertz *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 2 1970 21 p refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

A magnetic field simulator, used for magnetic measurement of the Azur satellite, is described. The subsystems, such as coil system, power supply, and compensation unit for geomagnetic fluctuations, are explained. The methods used for measuring magnetic cleanliness, magnetic moments, as well as calibration of magnetometers, are discussed. ESRO

N71-12712# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
MOTION SIMULATORS FOR SPACE SIMULATION TESTS, PARTICULARLY THE AZUR SATELLITE SIMULATOR [BEWEGUNGSSIMULATOREN FUER WELTRAUMSIMULATIONSTESTS MIT BESONDERER BERUECKSICHTIGUNG DES SIMULATORS FUER DEN FORSCHUNGSSATELLITEN AZUR]
E. Leschonsky *In* DFVLR Space Simulation for Satellites and

Space Probes, Vol. 2 1970 54 p refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

A two-axis satellite motion simulator is driven by dc-motors so that the satellite orbital rotation about its longitudinal and transverse axis may be simulated in the vacuum chamber (pressure 10 to the −7th power Torr and cold wall temperature of −196 C). The transverse rotation is controlled by curved disks. Fe-Constantan thermoelements are used for temperature measurements in the satellite model. ESRO

N71-12713# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
THERMAL VACUUM FACILITIES FOR SPACECRAFT TESTING [THERMAL-VAKUUM-ANLAGEN FUER DEN TEST VON RAUMFLUGKOERPERN]
W. Hallmann *In its* Space Simulation for Satellites and Space Probes, Vol. 2 1970 28 p refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

The importance of the thermal vacuum test for spacecraft reliability is shown. Statistical data from U.S. investigations are used to prove this. From these results optimal test procedures may be derived. Finally, a short description is given of the construction of the DFVLR thermal vacuum test stand. ESRO

N71-12714# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
MEASURING TECHNIQUES: DATA ACQUISITION AND PROCESSING OF TEST OBJECTS IN SIMULATION CHAMBERS [MESSTECHNIK: ERFASSUNG UND VERARBEITUNG VON MESSDATEN DES TESTOBJEKTES IN SIMULATIONSKAMMERN]
K. Kramp *In its* Space Simulation of Satellites and Space Probes, Vol. 2 1970refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

Problems of measurement and processing of signals from satellite tests in thermal and space environment simulation chambers are discussed. After a survey of type and number of measurement data and sensors, details of signal control are described. Some data processing equipment is also described. Some examples of tests on the satellites Azur and DIAL are given. ESRO

N71-12715# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
SIMULATION FACILITIES FOR SATELLITE VIBRATION TESTS [SIMULATIONSANLAGEN FUER VIBRATIONSTESTE AN SATELLITEN]
E. Koppe *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 2 1970 18 p refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

A short survey is given of the most important components for vibration testing of satellites and the necessary measuring and auxiliary equipment. ESRO

N71-12716# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Raumfahrt.
DIFFERENT STAGES DURING ENVIRONMENTAL TESTS OF SATELLITES [DIE VERSCHIEDENEN STUFEN BEI DER DURCHFUEHRUNG DER UMWELTERPROBUNG VON SATELLITEN]
W. Fueting *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 2 1970 18 p refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

A description is given of an environmental testing sequence for satellites, which has been generally accepted. The essential characteristics of the applied method are shown to be the division of the tests into kinds of loads, integration stages and development stages. ESRO

N71-12717# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
SPACE ENVIRONMENT SIMULATION AND THERMAL VACUUM TESTS [WELTRAUMSIMULATIONS- UND THERMALVAKUUMTESTE]
P. Kleber *In its* Space Simulation for Satellites and Space Probes, Vol. 2 1970 18 p In GERMAN (See N71-12710 03-11)
Avail: NTIS

It is shown that for spacecraft testing both space environment simulation, and thermal vacuum tests are necessary. Details of these testing methods are given. ESRO

N71-12718# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
ANALYSIS OF DIFFERENCE BETWEEN SPACE AND SIMULATED THERMAL CONDITIONS [THERMISCHE FEHLERBETRACHTUNG AN EINEM TESTKOERPER ZWISCHEN WELTRAUM- UND SIMULATIONSBEDINGUNGEN]
W. Hallmann *In its* Space Simulation for Satellites and Space Probes, Vol. 2 1970 78 p refs In GERMAN (See N71-12710 03-11)
Avail: NTIS

The differences between simulation and real environment are interpreted as a temperature inaccuracy of a test object in a space simulation chamber, in order to derive from these artificial conditions the behavior under real conditions. ESRO

N71-12719# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).
SPACE SIMULATION FOR SATELLITES AND SPACE PROBES, VOLUME 3 [WELTRAUMSIMULATION FUER SATELLITEN UND RAUMSONDEN, BAND 3]
1970 294 p refs In GERMAN Proc. of the 8th Symp. on Space Technol., Aachen, 9–13 Mar. 1970; sponsored by Bundesmin. fuer Bildung und Wiss.
Avail: NTIS

CONTENTS:

1. MAGNETIC TESTS OF SATELLITES H. Froehlich (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) 44 p refs (See N71-12720 03-11)

2. ELECTRICAL TESTS OF SATELLITES AND PROBES R. Hommel and B. Kunz 18 p refs (See N71-12721 03-14)

3. THERMAL SPACE SIMULATION TESTS OF THE SCIENTIFIC SATELLITE AZUR J. Lorschiedter K. Koegler (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) 69 p refs (See N71-12722 03-11)

4. SYSTEMS INTEGRATION OF THE SCIENTIFIC SATELLITE AZUR AND THE SPACE ENVIRONMENT TESTS G. Albrecht (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, West Germany) 16 p (See N71-12723 03-11)

5. EXPERIENCE IN THE OPERATION OF TEST FACILITIES FOR SPACE SIMULATION TESTS OF THE SCIENTIFIC SATELLITES AZUR AND DIAL P. Kleber 30 p (See N71-12724 03-11)

6. DAMPING OF SATELLITE STRUCTURES: TECHNICAL POSSIBILITIES AND PRACTICAL EXPERIENCE DEMONSTRATED ON HEOS A1 AND DIAL SATELLITES E. D. Sach (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich) 50 p refs (See N71-12725 03-32)

7. SPACE SIMULATION TEST PREPARATION AND PERFORMANCE FOR HEOS-1 SATELLITE IN THE ESTEC SIMULATION FACILITIES E. Classen (ESRTC) 34 p refs (See N71-12726 03-11)

8. COSTS OF SATELLITE TESTING A. Kutzer (Ges. fuer Weltraumforsch.) 32 p refs (See N71-12727 03-34)

N71-12720# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Abteilung Elektronische Systementwicklung.
MAGNETIC TESTS OF SATELLITES [MAGNETISCHE TESTE AN SATELLITEN]

H. Froehlich *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 3 1970 44 p refs In GERMAN (See N71-12719 03-11)
Avail: NTIS

The influence of magnetic perturbations on attitude control and measurement of passive magnetically controlled satellites is discussed. A description is given of the influence of the magnetic perturbations on spin-stabilized satellites and of a method to compensate these perturbations. As an example of the digital simulation of dynamic attitude motion of satellites the tests are described, which have been carried out on a model of the Azur satellite. ESRO

N71-12722# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
THERMAL SPACE SIMULATION TESTS OF THE SCIENTIFIC SATELLITE AZUR [THERMISCHE WELTRAUMSIMULATIONSTESTE AM FORSCHUNGSSATELLITEN AZUR]
J. Lorschiedter and K. Koegler *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 3 1970 69 p refs In GERMAN (See N71-12719 03-11)
Avail: NTIS

The development of models, including the choice of thermal control coatings, measurement of heat transfer, and realization of the dissipation energy is discussed. The temperature measurement points are indicated and the test programs are described. Experiments in testing the heat budget are given. The solar simulator's intensity problem is discussed in detail and compared to the dissipation energy of prototype and flight models. The test temperatures for several extreme orbits are discussed. Test and calculated data based on examples are compared. ESRO

N71-12723# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Raumfahrt.
SYSTEMS INTEGRATION OF THE SCIENTIFIC SATELLITE AZUR AND THE SPACE ENVIRONMENT TESTS [DIE INTEGRATION DES FORSCHUNGSSATELLITEN AZUR UND DIE ZUGEHOERIGEN UMWELTPRUEFUNGEN]
G. Albrecht IN DFVLR Space Simulation for Satellites and Space Probes, Vol. 3 1970 15 p In GERMAN (See N71-12719 03-11)
Avail: NTIS

The mechanical and electrical integration of subsystems and several environmental tests of the integrated system, including functional tests, are demonstrated for the Azur satellite. A sketch of launching preparations is also given. ESRO

N71-12724# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
EXPERIENCE IN THE OPERATION OF TEST FACILITIES FOR SPACE SIMULATION TESTS OF THE SCIENTIFIC SATELLITES AZUR AND DIAL [ERFAHRUNGEN BEIM BETRIEB DER TESTANLAGEN FUER DIE WELTRAUMSIMULATIONSTESTE DER FORSCHUNGSSATELLITEN AZUR UND DIAL]
P. Kleber *In its* Space Simulation for Satellites and Space Probes, Vol. 3 1970 30 p In GERMAN (See N71-12719 03-11)
Avail: NTIS

The program planning and coordination of the stages in the environmental simulation and thermal vacuum tests of the Azur and DIAL projects are described in the following phases: preparatory phase, test execution, and end of test. ESRO

N71-12726# European Space Research and Technology Center, Noordwijk (Netherlands).
SPACE SIMULATION TEST PREPARATION AND PERFORMANCE FOR HEOS-1 SATELLITE IN THE ESTEC SIMULATION FACILITIES [VORBEREITUNG UND DURCHFUEHRUNG DER WELTRAUMSIMULATIONS-TESTE DES FORSCHUNGSSATELLITEN HEOS-1 IN DEN ESTEC SIMULATIONSANLAGEN]
E. Classen *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 3 1970 34 p refs In GERMAN (See N71-12719 03-11)
Avail: NTIS

A report is given on the environmental tests in the ESTEC heat balance facilities of the HEOS-1 satellite model. After a short description of the HEOS satellite and the ESTEC heat balance the preparation of the facility and the first test procedure of the thermal model are described. The prototype and flight vehicle tests are only shortly reported on with reference to particular problems. ESRO

N71-12736*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LUNAR FLYING PLATFORM SIMULATOR
David F. Thomas, Jr. and Paul R. Hill Washington Dec. 1970 21 p refs
(NASA-TN-D-6001; L-6829) Avail: NTIS CSCL 14B

The construction and operation of a body-motion-controlled five-degree-of-freedom simulation of a jet-supported lunar flying platform is described. Results from a number of short investigations performed with this simulator are presented. In addition, a comparison is made of the equations of motion of a flying platform and this device; this comparison indicates that this device may be used to provide, in earth gravity, a reasonably accurate five-degree-of-freedom simulation of a jet-supported lunar flying platform. Author

N71-13076# Oak Ridge National Lab., Tenn.
THE CASE FOR NATIONAL ENVIRONMENTAL LABORATORIES
D. J. Ross, H. I. Adler, N. G. Anderson, S. I. Auerbach, S. E. Beall et al 17 Feb. 1970 66 p refs
(Contract W-7405-eng-26)
(PB-189691; ORNL-TM-2887) Avail: NTIS CSCL 14B

The report suggests the establishment of several large generalized National Environmental Laboratories (NELs), each containing interacting groups of natural and social scientists, engineers, and information specialists. The field of action is the whole environment, both urban and rural, both present and future. The tasks hitherto separately considered are joined in NELs, because: (1) environmental restoration and preservation involve prior and present technology decisions; assessment of future technology is the forward equivalent; (2) one of the activities tends to be conservationist, the other expansionist, and the two provide useful balance. Author (USGRDR)

N71-13156# Brookhaven National Lab., Upton, N.Y. Accelerator Dept.
THE NEW LOW FREQUENCY RIPPLE CORRECTING SYSTEM FOR THE CONVERTED AGS
T. Canides, J. G. Cottingham, S. E. Eiseman, and A. V. Feltman 6 May 1970 11 p refs
(BNL-14859) Avail: NTIS

The ripple correcting system for the converted AGS uses a combination of passive manually programmed, and dynamic systems to achieve the required regulation of magnet voltage during flat top. Author (NSA)

N71-13157# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PLANS FOR THE STORAGE RING AND DETECTION APPARATUS AT DESY
K. Steffen Jun. 1970 30 p refs Presented at the 2nd Princeton Conf. on Storage Ring Phys., Princeton, 26 May 1970
(DESY-70/24) Avail: AEC Depository Libraries

Topics include main features of the storage ring, dynamic

control of the RF system, additional 50 MHz RF system, some features of beam optics, general experimental facilities, a 1.4 meter magnetic detector, and luminosity monitors. NSA

N71-13160# Brobeck (William M.) and Associates, Berkeley, Calif.
THE CONCEPTUAL DESIGN OF THE BEAM TRANSPORT MAGNETS FOR BEAM LINE 1
P. F. Meads, Jr., E. L. Oster, O. K. Fredriksson, and T. E. McIlraith May 1970 74 p refs Prepared for TRI-Univ. Meson Facility
(TRI-70-1) Avail: AEC Depository Libraries

The preliminary design of the beam transport system for TRIUMF beam line 1 is reviewed. Four basic systems were studied, namely: (1) a system with three 30 deg bending magnets where the middle magnet creates a reverse bend (reverse bend system); (2) a modified achromatic system with three or four identical gradient bending magnets (gradient magnet bend system); (3) a modified-achromatic system with two 15 deg bending magnets (two magnet bend system); and (4) a dispersion-correcting system with one 30 deg bending magnet having wedge-shaped poles (single magnet bend system/wedge magnet), and (b) a dispersion correcting system with one 30 deg bending magnet having rectangular poles (single magnet bend system/rectangular magnet). Based on the results of the study work done, it is recommended that a dispersion correcting beam transport system consisting of eight quadrupole magnets, a combination magnet and a 30 deg bending magnet, both with square pole tip edges, be used in beam line 1. Author (NSA)

N71-13167# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
A NEW REMOTE POSITIONING FACILITY FOR THE CALIBRATION OF GAMMA RADIATION INSTRUMENTS AT HIGH EXPOSURE RATES
A. Lavender Mar. 1970 13 p refs
(RD/B/N-1624) Avail: AEC Depository Libraries

A facility was constructed for the remote selection of either a 3.5 Ci or a 21 Ci Co-60 source and its safe transfer to calibration jigs in a well-shielded cell. Exposure levels from a few R.h(−1) to thousands of R.h(−1) are obtained by remote positioning of the instrument calibration stand relative to the selected source. When handling such large sources, safety of operating personnel is of prime importance and hence the facility was designed so that all operations are controlled from outside the shielded exposure room. Author (NSA)

N71-13168# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
A RADIONUCLIDE IDENTIFICATION FACILITY AT BERKELEY NUCLEAR LABORATORIES
H. M. Christie Apr. 1970 41 p refs
(RD/B/N-1600) Avail: AEC Depository Libraries

The equipment and techniques available for the measurement and identification of alpha, beta, X- and gamma-emitting radionuclides are described. Author (NSA)

N71-13237# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
WIND TUNNELS AND TEST RIGS OF THE DEPARTMENT OF AERONAUTICS, IMPERIAL COLLEGE
P. Bradshaw Apr. 1970 6 p
(IC-AERO-REPT-70-01) Avail: NTIS

Details and dimensions of 14 test rigs used for teaching and research, ranging from a water channel to a Mach 25 nitrogen tunnel, are tabulated. Author (ESRO)

N71-13250# Oregon State Univ., Corvallis. Dept. of Oceanography.
ENGINEERING DESIGN AND USAGE OF THE TOTEM BUOY
David A. Young and Steve Neshyba Jun. 1970 41 p refs Sponsored in part by Navy
(Proj. Themis)
(AD-712772; TR-187; Rept-70-19) Avail: NTIS CSCL 13/10

A summary of engineering and design criteria for the total system and component parts for Totem Buoy, including consideration of design and deployment of a two-point mooring system. How these criteria were met and tested by TOTEM I is also included. Author (TAB)

N71-13316# Coast Guard, Washington, D.C. National Data Buoy Development Project.
INDUSTRIAL DATA USERS MEETING
1970 189 p Meeting held at Arlington, Va., 12-14 May 1970
(AD-712833) Avail: NTIS CSCL 13/10

Contents: Desired characteristics of national data buoy systems for satisfying environmental product needs of the offshore oil and gas industry; Conceptualization of a national data buoy system for the environmental data needs of the Gulf of Alaska oil and gas industry; Definition of national data buoy systems to satisfy the environmental data needs of ocean mining; Potential of national data buoy systems in satisfying environmental data needs of the shrimp fishing industry; How can national data buoy systems serve the commercial fishing industry; Recreational boatings environmental data product needs that can be improved by national data buoy systems; Potential of national data buoy systems for satisfying the environmental data needs of the marine construction industry; Potential use of national data buoy systems environmental data in optimum ship track routing; How will the commercial aviation industry exploit the availability of environmental data from the national data buoy system; Summary working group presentations. TAB

N71-13344# Tri-Univ. Meson Facility, Vancouver (British Columbia).
VACUUM SYSTEM MODEL STUDY FOR A 500 MeV H(−) CYCLOTRON
Vivienne J. Harwood and J. C. Yandon Dec. 1969 57 p refs
(TRI-69-7) Avail: AEC Depository Libraries

Using a 1:20 scale model of the TRIUMF vacuum chamber, simulation of chamber pumpdown performance with two different pumping system designs is described. Large trapped oil diffusion pumps and a 20 K cryopumping system, having auxiliary means for pumping hydrogen, are compared in relation to the design criterion of an equivalent nitrogen stripping cross-section pressure of 7 × 10 to the minus 8th power Torr within 15 hours of pumping. It is shown that the design criterion can be satisfied by the cryopumping system only, when a polyurethane main chamber seal is used; for this condition resonator bakeout is not required. This result will be valid for the full-scale machine, provided by more than a factor of 3. The component outgassing rates for stainless steel with different surface treatments are discussed. Data obtained prior to and following bakeout under vacuum to 80 C and 140 C, and air baking to 150 C, are considered. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N71-12567*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF PREDICTED AND EXPERIMENTAL CAVITATION PERFORMANCE OF 64 DEG HELICAL INDUCER IN WATER AND HYDROGEN

George Kovich Washington Dec. 1970 23 p refs
(NASA-TN-D-7016; E-5711) Avail: NTIS CSCL 20D

The cavitating performance of an 84 deg flat-plate helical inducer was investigated in water over a range of liquid temperatures and flow coefficients. A semiempirical prediction method was used to compare predicted values of required net positive suction head in water with experimental values obtained in water and in liquid hydrogen. Good agreement between predicted and experimental data was obtained both in water and in hydrogen. The required net positive suction head in water decreased with increasing temperature and increased with flow coefficient, similar to that observed for liquid hydrogen. Author

N71-12582# Advisory Group for Aerospace Research and Development, Paris (France).

NONREACTING AND CHEMICALLY REACTING VISCOUS FLOWS OVER A HYPERBOLOID AT HYPERSONIC CONDITION

Clark H. Lewis, ed. Sep. 1970 160 p refs
(AGARDograph-147; AGARD-AG-147-70) Avail: NTIS

CONTENTS:

1. A SURVEY OF HIGHER-ORDER BOUNDARY-LAYER THEORY M. Van Dyke (Stanford Univ., Calif.) p 1 - 12 refs (See N71-12583 03-12)

2. FINITE DIFFERENCE SOLUTION OF THE FIRST-ORDER BOUNDARY LAYER EQUATIONS F. G. Blottner (Sandia Corp., Albuquerque, N.Mex.) p 13 - 36 refs (See N71-12584 03-12)

3. LAMINAR BOUNDARY LAYER CALCULATIONS ON BODIES OF REVOLUTION IN HYPERSONIC FLOW G. L. Keltner and A. M. O. Smith (Douglas Aircraft Co., Inc., Long Beach, Calif.) p 37 - 54 refs (See N71-12585 03-12)

4. SOLUTION OF THE VISCOUS SHOCK-LAYER EQUATIONS FOR A BINARY MIXTURE R. T. Davis (Virginia Polytechnic Inst., Blacksburg) p 55 - 70 refs (See N71-12586 03-12)

5. VISCOUS SHOCK-LAYER PROBLEM FOR THE STAGNATION POINT OF A BLUNT BODY F. G. Blottner (Sandia Corp., Albuquerque, N.Mex.) p 71 - 88 refs (See N71-12587 03-12)

6. CHEMICALLY REACTING BOUNDARY LAYER EFFECTS FOR THE AGARD ENGINEERING APPLICATIONS BODY AND FLOW CONDITIONS J. C. Adams, Jr. (ARO, Inc., Arnold Air Force Station, Tenn.) p 89 - 104 refs (See N71-12588 03-12)

7. COMPUTATION OF HIGHER-ORDER BOUNDARY-LAYER EFFECTS WITH A FIRST-ORDER TREATMENT AND COMPARISON WITH EXPERIMENTAL DATA C. H. Lewis (Virginia Polytechnic Inst., Blacksburg) p 105 - 120 refs (See N71-12589 03-12)

8. HIGHER ORDER BOUNDARY-LAYER EFFECTS FOR THE AGARD ENGINEERING APPLICATIONS BODY AND FLOW CONDITIONS J. C. Adams, Jr. (ARO, Inc., Arnold Air Force Station, Tenn.) p 121 - 134 refs (See N71-12590 03-12)

9. THE HYPERSONIC VISCOUS SHOCK-LAYER PROBLEM R. T. Davis (Virginia Polytechnic Inst., Blacksburg) p 135 - 154 refs (See N71-12591 03-12)

10. NUMERICAL METHODS FOR NONREACTING AND CHEMICALLY REACTING LAMINAR FLOWS: TESTS AND COMPARISONS C. H. Lewis (Virginia Polytechnic Inst., Blacksburg) p 155 - 170 refs (See N71-12592 03-12)

N71-12583# Stanford Univ., Calif.

A SURVEY OF HIGHER-ORDER BOUNDARY-LAYER THEORY

Milton Van Dyke *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 1 - 12 refs (See N71-12582 03-12)
Avail: NTIS

Results of a survey conducted on higher order boundary layer theory are presented. Discussed are: (1) displacement effect; (2) one-and-a-half-order theory; (3) longitudinal curvature; (4) transverse curvature; (5) external vorticity; (6) method of matched asymptotic expansions; (7) compressible flow; (8) laminar separation; (9) corners and edges; and (10) singular outer flows. A.L.

N71-12584# Sandia Corp., Albuquerque, N.Mex. Thermodynamics Dept.

FINITE DIFFERENCE SOLUTION OF THE FIRST-ORDER BOUNDARY LAYER EQUATIONS

F. G. Blottner *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 13 - 36 refs (See N71-12582 03-12)
Avail: NTIS

A review of various methods for solving the laminar boundary layer equations by numerical techniques is given. The emphasis is on the finite difference schemes that have been employed recently and how the presently employed techniques have evolved. The governing equations are presented in the similarity coordinate system for a multicomponent gas with finite reaction rates. An implicit finite difference technique is presented which is appropriate for solving flows with a large number of chemical species, as occurs with ablation contaminants. This method does not require iterations at each step, and solutions can be obtained when the gas is near chemical equilibrium. Two test cases are presented for the boundary layer flow on a sharp cone and hyperboloid at reentry conditions. Author

N71-12585# Douglas Aircraft Co., Inc., Long Beach, Calif.

LAMINAR BOUNDARY LAYER CALCULATIONS ON BODIES OF REVOLUTION IN HYPERSONIC FLOW

Gerlina L. Keltner and A. M. O. Smith *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 37 - 54 refs (See N71-12582 03-12)
Avail: NTIS

Two sets of laminar boundary layer problems in hypersonic flow are presented. One set consists of boundary layer calculations for equilibrium, frozen and nonequilibrium flows on a hyperboloid of revolution for a high Reynolds number at Mach 20 and a low Reynolds number at Mach 22. The results are presented for each Reynolds number showing a comparison between the three types of flows on the body. The other set consists of boundary layer calculations for experimental equilibrium flows on two three-quarter power law bodies of revolution at Mach 8 and comparisons with experimental boundary layer measurements. The results did not compare well with experiment since this was a case where the conditions assumed when deriving the inviscid flow theory used to obtain additional data from the experimental pressure distributions were violated by the experimental conditions. The boundary layer calculations were done on the IBM 7094 using two boundary layer programs already in existence, one for the equilibrium boundary layers and the other for the frozen and nonequilibrium boundary layers. Real gas fluid properties were used for the equilibrium cases on the hyperboloid and ideal gas fluid properties were used for the cases on the power law body. Fluid properties derived for a binary air model were used for the frozen and nonequilibrium cases. The binary model was improved by making modifications to the fluid properties as originally programmed. Author

N71-12586# Virginia Polytechnic Inst., Blacksburg.

SOLUTION OF THE VISCOUS SHOCK-LAYER EQUATIONS FOR A BINARY MIXTURE

R. T. Davis *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 55 - 70 refs (See N71-12582 03-12)
Avail: NTIS

The method of solution of the viscous shock layer equations for a one component perfect gas is extended to the case of a binary mixture consisting of oxygen atoms and molecules. Two altitude conditions are considered which correspond to either AGARD

Case A or Cases B and C. The method of solution is identical to the method used to solve the one component perfect gas case except care must be taken in expressing the rate of production of atoms term in both the energy and species equations. Stanton number, wall pressure, and skin friction distributions are presented along with velocity, temperature, and atom concentration profiles. Author

N71-12587# Sandia Corp., Albuquerque, N.Mex. Thermodynamics Dept.

VISCOUS SHOCK-LAYER PROBLEM FOR THE STAGNATION POINT OF A BLUNT BODY

F. G. Blottner *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 71-88 refs (See N71-12582 03-12)

Avail: NTIS

A finite difference method and a nonlinear overrelaxation method are investigated for solving the viscous shock layer at the stagnation point of a blunt body. An air gas model is employed with finite reaction rates and accurate thermodynamic and transport properties. For a body with a 1-inch nose radius and at a velocity of 20 Kfps, the present results at 100, 150, 200, and 250 Kft show that boundary layer theory is appropriate for some altitude below 150 Kft. When the altitude is 250 Kft, the effects of shock slip must be included in the viscous shock layer solution. For this case, the air is only slightly dissociated and ionized. Author

N71-12588# ARO, Inc., Arnold Air Force Station, Tenn. Von Karman Gas Dynamics Facility.

CHEMICALLY REACTING BOUNDARY LAYER EFFECTS FOR THE AGARD ENGINEERING APPLICATIONS BODY AND FLOW CONDITIONS

John C. Adams, Jr. *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 89-104 refs (See N71-12582 03-12)

Avail: NTIS

Numerical results for chemical nonequilibrium boundary layer flow at the AGARD Case B condition (flight in the earth's atmosphere at 250,000 ft and 20,000 ft/sec) are presented for the AGARD 10.0 deg asymptotic half-angle hyperboloid having a nose radius of 1.0 inch and a wall temperature of 1800.0 R. The boundary layer model allows multicomponent diffusion and both catalytic and noncatalytic walls. Also presented are stagnation point results for the above body and flight conditions using a thin viscous shock layer analysis allowing chemical nonequilibrium and shock merging effects for both wall conditions including multicomponent diffusion. Analysis of the results reveals that boundary layer theory is not applicable to the AGARD Case B flow condition, and that only the merged thin viscous shock layer stagnation point analysis may be expected to have any physical meaning. However, boundary layer results are presented over the entire body so as to facilitate comparison with other theoretical and numerical solutions for the same body and flow conditions. Author

N71-12589# Virginia Polytechnic Inst., Blacksburg.

COMPUTATION OF HIGHER-ORDER BOUNDARY-LAYER EFFECTS WITH A FIRST-ORDER TREATMENT AND COMPARISON WITH EXPERIMENTAL DATA

Clark H. Lewis *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 105-120 refs (See N71-12582 03-12)

Avail: NTIS

The effects of transverse curvature, shock generated external vorticity, boundary layer displacement, wall slip, and temperature jump are considered as first-order boundary layer effects. The classical boundary layer equations were modified to include the higher order effects, and flows over a 9 deg half-angle blunt cone were considered at M sub infinity = 9 and 18. Comparisons are made with second-order theory and experimental data. Primary interest is given to predicting the higher order effects on zero lift drag and comparison with experimental data. Range of applicability of higher order boundary layer theory is indicated based upon the ability to predict zero lift drag. Vorticity was the dominant higher order effect, and the theory is most applicable to relatively short slender bodies. At very low Reynolds numbers, strong coupling of the higher order effects was found to exist. Author

N71-12590# ARO, Inc., Arnold Air Force Station, Tenn. Von Karman Gas Dynamics Facility.

HIGHER ORDER BOUNDARY-LAYER EFFECTS FOR THE AGARD ENGINEERING APPLICATIONS BODY AND FLOW CONDITIONS

John C. Adams, Jr. *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 121-134 refs (See N71-12582 03-12)

Avail: NTIS

Numerical results for perfect gas boundary layer flow at the AGARD Case C condition are presented for the AGARD 10.0 deg asymptotic half-angle hyperboloid. The boundary layer model utilizes first- and second-order boundary layer theory which accounts for displacement, external vorticity, longitudinal curvature, transverse curvature, slip, and temperature jump effects. Analysis of the results reveals that the AGARD Case C flow regime is such that second-order boundary layer theory is not applicable since the boundary layer thickness is much greater than the vortical (entropy layer) thickness so that correct asymptotic matching of the two layers is not possible. Hence the numerical results presented have little meaning relative to the physical problem; however, the results are presented in a manner specified by AGARD so as to facilitate comparison with other theoretical and numerical solutions for the same body and flow conditions. Author

N71-12591*# Virginia Polytechnic Inst., Blacksburg.

THE HYPERSONIC VISCOUS SHOCK-LAYER PROBLEM

R. T. Davis *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersonic Condition Sep. 1970 p 135-154 refs (See N71-12582 03-12)

(Grant NGR-47-004-006)

(NASA-CR-111571) Avail: NTIS CSCL 20D

Laminar flow past axisymmetric blunt bodies moving at hypersonic speeds is considered on the basis of a set of equations which govern the fully viscous shock layer for moderate to high Reynolds numbers. The shock layer equations are derived by writing the full Navier-Stokes equations in boundary layer coordinates and performing an order of magnitude analysis on the terms in the equations. Terms are kept up to second order in the inverse square root of the Reynolds number from both a viscous and an inviscid viewpoint, so that the simplified governing equations are uniformly valid to moderately low Reynolds numbers. To the order of the approximations involved the body surface conditions are given by slip and temperature jump conditions while a set of shock slip conditions are used to determine conditions behind the shock. The thin shock layer approximation is then applied to the simplified set of governing equations, and the resulting equations are found to be of parabolic type. This is an important simplification as far as numerical solution of the problem is concerned since these equations can be solved by numerical methods similar to those developed for solving the boundary layer equations. The numerical procedure consists of finding initial data at the stagnation point and then integrating downstream using an implicit finite difference method. The thin shock layer approximation is then removed by iteration. New dependent variables are defined by dividing the old dependent variables by their local values at the shock. Examples are presented to demonstrate the method and to compare with second-order boundary layer theory. Author

N71-12592# Virginia Polytechnic Inst., Blacksburg.

NUMERICAL METHODS FOR NONREACTING AND CHEMICALLY REACTING LAMINAR FLOWS: TESTS AND COMPARISONS

Clark H. Lewis *In* AGARD Nonreacting and Chemically Reacting Viscous Flows over a Hyperboloid at Hypersoic Condition Sep. 1970 p 155 - 170 refs (See N71-12582 03-12)
Avail: NTIS

Equilibrium, nonequilibrium, and ideal gas laminar boundary layers and viscous shock layers over a 10 deg half angle hyperboloid 50 nose-radii long at three altitude-velocity conditions were computed by several investigators. Results of skin friction and heat transfer coefficients and displacement thickness distributions over the body and property profiles across the layer at the ends of the body were compared. The conditions chosen test the ability of the numerical methods to compute nonequilibrium viscous layers near chemical equilibrium and the applicability of boundary layer theory at low Reynolds number conditions. Results show that recently developed finite difference methods are superior to earlier methods. Author

N71-12673# Advisory Group for Aerospace Research and Development, Paris (France).
THE NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS GOVERNING CONVECTION
Harvard Lomax, Paul Kutler, and F. B. Fuller Oct. 1970 54 p refs
(AGARDograph-146) Avail: NTIS CSCL 20D

The time-dependent Navier-Stokes equations are a mathematical model for fluid flows that contain two quite different physical phenomena. These phenomena are contained in the formula representing the conservation of momentum and are referred to as convection and dissipation. The optimum numerical reduction from differential to difference equations of the terms that model these two aspects of fluid flow can be quite different. A simple but systematic study of the numerical methods best suited for the analysis of convection is described. Author

N71-12674# National Physical Lab., Teddington (England). Aerodynamics Div.
TEST CASES FOR NUMERICAL METHODS IN TWO-DIMENSIONAL TRANSONIC FLOWS
R. C. Lock, comp. Paris AGARD Nov. 1970 25 p refs
(AGARD-R-575-70) Avail: NTIS

In order to provide test cases for the development of numerical methods for the computation of two-dimensional transonic flows round airfoils, six airfoil shapes were selected for which accurate solutions are available. These include both symmetrical and cambered profiles, non-lifting and lifting, in subcritical and supercritical (shock-free) flow. Author

N71-12691# Oak Ridge National Lab., Tenn. Reactor Div.
DROPLET SIZE DISTRIBUTION IN SPRAY
Shiro Matsumoto et al May 1970 15 p refs Transl. into ENGLISH from Kagaku Kogaku (Tokyo), v. 33, no. 4, 1969 p 357 361 In ENGLISH and JAPANESE
(PB-192171T; ORNL-tr-2335) Avail: NTIS CSCL 20D

A droplet size distribution considering a probability process of random walk is presented as the first approximation by log normal distribution. Author (USGRDR)

N71-12692# Oak Ridge National Lab., Tenn. Reactor Div.
A FORMATION AND MOVEMENT OF DROPLET (NO. 2) (IN GAS-LIQUID PHASE)
Yoichi Takashima May 1970 19 p Transl. into ENGLISH from Kagaku Kogaku (Tokyo), v. 31, no. 5, 1967 p 414-420 In ENGLISH and JAPANESE
(PB-192170T; ORNL-tr-2334) Avail: NTIS CSCL 20D

The atomization of a fluid is described. USGRDR

N71-12762# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
THEORETICAL AND EXPERIMENTAL JET MIXING OF AN ECCENTRIC PRIMARY JET IN A CONSTANT AREA DUCT
W. Tabakoff and W. M. Hosney Jul. 1970 54 p refs
(Contract DAHC04-69-C-0016; Proj. Themis)
(AD-712333; THEMIS-AE-70-11) Avail: NTIS CSCL 20/4

The problem of turbulent mixing between two compressible streams in a constant duct area and with eccentric primary flow jet is analyzed. A theoretical analysis is presented for the velocity profiles. It was found that these profiles with or without eccentricity are almost the same if they are referred to the axis of the primary flow jet. An experimental investigation for the case of eccentricity ratio (e/R) equal to 0.25, given area ratios 3 and 7.16 and with a velocity ratio ranging from 1.2 to 2.9 was performed. The theoretical analysis shows good agreement with the experimental results, especially for cases with high area ratios and with low velocity magnitudes. Author (TAB)

N71-12763# National Physical Lab., Teddington (England). Ship Div.
THE 1957 ITTC MODEL-SHIP CORRELATION LINE VALUES OF FRICTIONAL RESISTANCE COEFFICIENT
A. Morrall Jun. 1970 10 p
(NPL-Ship-142) Copyright. Avail: NTIS

The advantages to be gained by using tabulated values of frictional resistance coefficients from the 1957 ITTC model-ship correlation line for given Reynolds number, become apparent when executing ITTC resistance and propulsion analysis. The tables have been extended to six significant figures and to Reynolds numbers of 10 to the 10th power. Author (ESRO)

N71-12766*# Southwest Research Inst., San Antonio, Tex.
DYNAMIC INTERACTION BETWEEN STRUCTURE AND LIQUID PROPELLANTS IN A SPACE SHUTTLE VEHICLE MODEL. PART 1 Final Report
Daniel D. Kana, William L. Ko, Philip H. Francis, and Andrew Nagy 15 Oct. 1970 97 p refs
(Contract NAS1-9890; SwRI Proj. 02-2820)
(NASA-CR-111801) Avail: NTIS CSCL 20D

The applicability of existing analytical techniques is examined for studying the coupled liquid-structural dynamics of a typical space shuttle configuration, a parallel-stage design. A suitable experimental model was developed that is capable of experiencing at least the most fundamental structural dynamics of a prototype system, measuring its natural frequencies of vibration for a range of various parameters, and comparing the results with those predicted from a corresponding analytically derived model. Existing concepts of spring-mass fluid models, which were derived to simulate liquid reactions for decoupled lateral and longitudinal motions, are employed in a straightforward manner in a system which experiences strong coupling along these axes. The results of this study of a rather fundamental model will point toward the path to follow for more complex representations of a shuttle system. A description of the physical model, an outline of the analysis, and results and conclusions from the study are presented. Author

N71-12767*# Southwest Research Inst., San Antonio, Tex.
PROPELLANT DYNAMIC PROBLEMS IN SPACE SHUTTLE VEHICLES, PART 2 Final Report
William J. Astleford, Wen-Hwa Chu, and Franklin T. Dodge 15 Oct. 1970 70 p refs
(Contract NAS1-9890, SwR; Proj. 02-2820)
(NASA-CR-111802) Avail: NTIS CSCL 20D

The analysis is presented of three fluid dynamic problems important in space shuttle design: dome impact; sloshing in tanks for which the thrust vector is not aligned with the tank axis; and hydraulic jumps in long, shallow tanks. Author

N71-13006*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTAL DETERMINATION OF LIQUID OSCILLATION FREQUENCY IN AN INCLINED RIGHT CIRCULAR CYLINDER

Frank Bugg 20 Nov. 1970 17 p refs
(NASA-TM-X-64540) Avail: NTIS CSCL 20D

An experimental investigation was performed to determine the frequency of liquid oscillations in a right circular cylinder tank tilted at 0, 30, 45, and 60 degs to the local vertical. The liquid depth was also varied. Two modes of oscillation were studied, one with its nodal line along the minor axis of the liquid free surface and one with its nodal line along the major axis of the surface. The frequency of each of these modes was decreased by increasing the tank tilt, with the frequency of the former being decreased much more than the frequency of the latter. Author

N71-13019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL STUDY OF FLOW SEPARATION IN OVEREXPANDED CONICAL NOZZLES

O. S. Zelenkov et al 17 Jul. 1970 12 p refs Transl. into ENGLISH from Uch. Zap. (Leningrad), no. 338, 1968 p 94–101
(AD-712943; FTD-HT-23-290-70) Avail: NTIS CSCL 20/4

The position of the flow separation point in the nozzle is studied as a function of the pressure gradient and the aperture angle of the nozzle. Author (TAB)

N71-13028# Institut Franco-Allemand de Recherches, St. Louis (France).

STUDY OF A PYRAMID SHAPED SHOCK TUBE FOR THE GENERATION OF AN N-WAVE: CONTINUATION OF NOTE N 1/69 [ETUDE D'UN TUBE A CHOC DE FORME PYRAMIDALE POUR LA GENERATION D'UNE ONDE EN N: SUITE A LA NOTICE N 1/69]

A. Peter and J. J. Brunner 1970 88 p refs In FRENCH
(T-11/70) Avail: NTIS

Acoustic theory is used to analyze shock wave generation in a spherical shaped simulator and to study certain distortions that can be expected when simulator geometry is altered. Described are experiments with simulator models to verify geometrical parameter effects of the tube on the wave profile (high pressure chamber geometry, generating angle of the tube, and slope changes in tube profile). Obtained results establish that the spherical geometry of the system has to be kept intact for the generation of proper N-waves. A quantitative study to develop a system that absorbs the wave after traveling through the chamber resulted in the addition of a second pyramid with side face openings to the expansion tube; the overall cross section of these openings should be about 10% of the cross section of the mouth of the expansion tube. Also reported is the conceptual design and construction of a simulation system of real proportions. Transl. by G.G.

N71-13029# Institut Franco-Allemand de Recherches, St. Louis (France).

MICROWAVE APPARATUS FOR THE SIMULTANEOUS MEASUREMENT OF THE PROPAGATION VELOCITY OF SHOCK WAVES AND OF THE STEADY FLOW TIME IN A SHOCK WAVE TUBE OF 10 cm DIAMETER [MIKROWELLENANLAGE ZUR GLEICHZEITIGEN MESSUNG DES GESCHWINDIGKEITSVERLAUFES VON STOSSWELLEN UND DER ZEIT DER GESUNDEN STROEMUNG IN EINEM STOSSWELLENROHR DIAMETER 10 cm]

M. Koenig 1969 35 p refs In GERMAN
(T-23/69) Avail: NTIS

Technical data and the construction of a digital Doppler velocity measuring system for determining shock wave propagation velocities in a shock tube are described. The method uses the Doppler effect of a microwave reflecting from the ionized shock wave front. Concurrent oscillatory transmission measurements between opposite microwave antennas determine the developing gas stream ionization degree behind the shock wave. Some measurement results show that air shock wave propagation velocity measurements up to Mach numbers of more than or equal to 8 give good results. The relative accuracy of the individual measurement point is in the vicinity of some 0.001. Author

N71-13046*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A SEMIEMPIRICAL MODEL FOR BOUNDARY LAYER DIFFUSION IN FORCED CONVECTION FLOW

Alex Vary Washington Dec. 1970 25 p refs
(NASA-TN-D-7012) Avail: NTIS CSCL 20D

The relation among the Sherwood, Schmidt, and Reynolds numbers is routinely used in liquid metal corrosion studies involving convective diffusion mass transfer from surfaces. A different form of this equation is presented for correlating convective mass flux with hydrodynamic and surface factors in liquid metal flows. A mass transfer coefficient is defined in terms of instantaneous mass flux and axial concentration gradient in the bulk stream. A mathematical model is proposed for the empirical evaluation of this mass transfer coefficient. The model shows that in-line concentration measurements are needed for valid correlations with hydrodynamic and surface factors. Author

N71-13048*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXTENSION TO LOWER PRESSURES OF THE NAVIER-STOKES THEORY FOR THE VISCOUS FLOW OF GASES BETWEEN RELATIVELY ROTATING COAXIAL CYLINDERS

Willard E. Meador Washington Dec. 1970 20 p refs
(NASA-TN-D-6092) Avail: NTIS CSCL 20D

An extension of the Grad 13-moment distribution function is applied to the velocity-linearized Boltzmann kinetic equation for the problem of viscous gases flowing between two relatively rotating coaxial cylinders. Precise boundary conditions are employed, and the results are compared with those obtained by using the obsolete Maxwellian separation of reflected particles into specular and diffuse groups. The solution is exact through quadratic terms in the Knudsen number and thus provides reliable generalizations of previous work to lower pressures; in particular, the Navier-Stokes expression for the torque experienced by the inner cylinder is shown to suffice for Knudsen numbers extending well into the transition flow regime if the separation between the cylinders is small compared with their radii. Low-pressure effects for larger ratios of these distances ar compared with calculations based on the Burnett equations. Author

N71-13059# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLIED GASDYNAMICS

G. N. Abramovich 24 Jul. 1970 100 p refs Transl. into ENGLISH from Prikl. Gaz. Dinamika (Moscow), 1969 p 438–515
(AD-712821; FTD-HC-23-88-70) Avail: NTIS CSCL 13/11

The general operating principles and applications of subsonic and supersonic gas ejectors are reviewed. The flow parameter variations inside an ejector are calculated. Critical operational regimes are defined and compared with experiment. Several example ejector designs are calculated for various applications. Author (TAB)

N71-13060# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.

PREDICTED AND MEASURED PRESSURE DISTRIBUTIONS ON TWO AIRFOILS AT MACH NO. 1 Annual Report

Frederick O. Smetana and Donald P. Knepper 1970 32 p
(Grant DA-ARO(D)-31-124-70-G98)
(AD-712397; AROD-8130.1-E) Avail: NTIS CSCL 20/4

The report describes the initial efforts of a study to provide fundamental understanding of transonic flow. It contains a partial description of apparatus and models used for the study including a continuous flow transonic wind tunnel and a comparison of the

experimental results with the available viscous transonic theory on two experimental airfoils. The report also contains a discussion of future work. Author (TAB)

N71-13081*# Southwest Research Inst., San Antonio, Tex.
FLOW-INDUCED VIBRATION OF BELLOWS WITH INTERNAL CRYOGENIC FLUID FLOWS Interim Technical Report
C. R. Gerlach, R. L. Bass, III, J. L. Holster, and E. C. Schroeder Aug. 1970 89 p refs
(Contract NAS8-21133; SwRI Proj. 02-2119)
(NASA-CR-102935; ITR-2) Avail: NTIS CSCL 20D

A theoretical and experimental study of heat transfer with respect to its effect on the flow-induced response of bellows when gas is formed in the convolutes and/or frost or liquid accumulates on the bellows exterior. The following are discussed: (1) bellows response in liquid nitrogen compared to test results for water and air; (2) heat transfer change of fluid physical properties in the bellows convolutions; (3) conditions predicted for heat transfer effects; and (4) effects of external buildup of ice, slush, and liquid. Author

N71-13082# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
OBSERVATIONS OF TUNNEL FLOW SEPARATION INDUCED BY AN IMPINGING JET
R. A. Tyler and R. G. Williamson Apr. 1970 22 p refs
(NRC-11617; LR-537) Avail: NTIS

Single jets were directed towards, and perpendicular to, the boundary of the 10-ft × 20-ft test section of the NRC V/STOL Propulsion Tunnel. The position of tunnel flow separation, arising from jet impingement and forward penetration, was determined from wool tuft observations for various conditions of jet geometry, jet velocity, and tunnel speed, relevant to V/STOL models involving discrete jets. The results indicated the separation position to be a simple function of the product of effective mainstream/jet velocity ratio and nozzle height/diameter ratio. A value of this product greater than 1.5 was found to be necessary to ensure tunnel flow separation downstream of the jet nozzle. An approximate extension to inclined jets, based on limited test data, is included. Author

N71-13083# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
DETAILED MEASUREMENTS IN THE TRANSITION REGION OF A TWO-DIMENSIONAL WAKE, VOLUME 453, NO. 11
Hiroshi Sato and Yoshio Onda Aug. 1970 60 p refs
(ISAS-453-Vol-35-No-11) Avail: NTIS

Detailed measurements were made on the laminar-turbulent transition of a two-dimensional wake with three kinds of imposed disturbances: the natural disturbance in a wind tunnel, a sound of single frequency, and a sound of two frequencies from outside. In all cases, the transition to turbulence is gradual. When a sound of single frequency is introduced into the wake, the induced velocity fluctuation is regular and periodic and it persists, resulting in a transition delay. When a sound of two frequencies f sub 1 and f sub 2 is introduced, two velocity fluctuations are induced. They grow independently while amplitudes are small. When amplitudes exceed certain values, two fluctuations interact and both amplitudes are reduced. The behavior of a slow, irregular fluctuation found in the natural transition resembles that of f sub 1 − f sub 2 component in many respects. Both fluctuations must be generated by the same process. The amplification of randomness in the transition process may be accomplished by the mutual suppression of amplitudes and by the generation of low-frequency components from high-frequency components. Author

N71-13084# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
A NUMERICAL STUDY OF SHOCK FORMATION IN CYLINDRICAL AND TWO-DIMENSIONAL SHOCK TUBES, VOLUME 35, NO. 9
Nobuyuki Satofuka Jun. 1970 24 p refs
(ISAS-451-Vol-35-No-9) Avail: NTIS

Summary: Shock formation process and shock tube performance are investigated numerically. FLIC method is proposed for solving compressible fluid flows. A model of diaphragm opening process which does not base on the usual one-dimensional assumption is presented. Four cases for cylindrical shock tubes and one for two-dimensional were calculated for diaphragm pressure ratios of 100 and 1000. Diaphragm opening times were varied from about 100 to 500 microsec. Shock formation process predicted from present calculations shows a qualitative agreement with experimental results. Shock tube performance was also calculated and compared with those predicted by ideal shock tube theory and other models such as formation-from-compression model and multistage model. Author

N71-13085*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
NUMERICAL SOLUTION OF LAMINAR JET MIXING WITH AND WITHOUT FREE STREAM
S. I. Pai and T. Y. Hsieh Nov. 1969 59 p refs
(Grant NsG-398; DAAG39-69-C-0036)
(NASA-CR-111517; AD-710232; BN-627) Avail: NTIS CSCL 20D

Systematic numerical solutions of two dimensional and axisymmetrical laminar jet of an incompressible fluid with and without free stream were obtained. The exact numerical solutions were checked with experimental results and similarity solutions for the case without free stream. At far downstream, the numerical solutions approach the values of similarity solution. The numerical solutions give better agreement with experimental data than the similarity solutions. In general, it shows that the boundary layer equation is a good approximation of laminar jet problem provided that the Reynolds number at nozzle exit is not too low. With free stream, the numerical solutions agree with linearized analytic solution if the jet excess velocity is small in comparison with the free stream velocity. The non-linear effects are to decrease the rate of decrease of central velocity of the jet and to broaden the spread of the jet. Also an approximate numerical solution for three dimensional laminar jet is proposed. The accuracy of the method was determined from the exact solutions of the two limiting cases of three dimensional jets, i.e., two dimensional and axisymmetric. It was found that this approximate method may give good results for the axial velocity distribution and the spread of three dimensional jet. Author (TAB)

N71-13117# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.
APPLICATIONS OF THE MARKER-AND-CELL NUMERICAL PROGRAM
C. R. Easton *In its* Proc. of Low-G Seminar May 1969 p 171−181 refs (See N71-13101 03-31)
Avail: NTIS

The development of the marker and cell technique to form two dimensional, transient solutions to the Navier-Stokes equations is discussed. The program based on this technique is adapted primarily to calculating the dynamics of a liquid in a partially filled container. The energy equation, together with the Boussinesq approximation to the body force in the momentum equations, has been added to provide the capability of treating natural convection problems. The solution of these equations is by explicit finite difference and forward time advancement. The continuity equation is evolved into a Poisson equation for pressure, which is solved by finite difference relaxation. Author

N71-13155# Naval Ordnance Lab., White Oak, Md.
EQUILIBRIUM NORMAL SHOCK PROPERTIES FOR VIBRATIONALLY EXCITED CO2-N2-He GAS MIXTURES

Final Report
Michael T. Madden, John D. Anderson, Jr., and Carolyn H. Piper
28 May 1970 76 p refs
(AD-712510; NOLTR-70-103) Avail: NTIS CSCL 20/4

Results are given for equilibrium properties behind incident and reflected normal shock waves in CO2-N2-He mixtures wherein the gas may be vibrationally excited but not chemically reacting. A rapid numerical iterative analysis is described, and the results are given in simple graphical form for convenient use in shock tube and shock tunnel experiments. The results are anticipated to be of particular use in determining reservoir conditions for shock tunnel experiments dealing with vibrational population inversions in rapidly expanding mixtures.
Author (TAB)

N71-13193# Oak Ridge National Lab., Tenn.
STUDIES ON DROPLET SIZE SPRAYED FROM HOLLOW CONE NOZZLES
Shiro Matsumoto et al May 1970 19 p refs Transl. into ENGLISH from Kagaku Kogaku (Tokyo), v. 34, no. 2, 1970 p 204–210 In ENGLISH and JAPANESE
(PB-192136T; ORNL-tr-2336) Avail: NTIS CSCL 20D

The changes of a geometrical mean size and logarithmic standard deviation which characterize a local distribution and log normal distribution is described experimentally by an operating condition, physical properties of fluid and a size of nozzle.
Author (USGRDR)

N71-13236# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
FLAT PLATE PRESSURE DISTRIBUTION AND HEAT TRANSFER IN A CONICAL HYPERSONIC FLOW
F. R. Bailey Jun. 1969 59 p refs
(VKI-TN-56) Avail: NTIS

A theory is presented for predicting the weak pressure interaction and heat transfer distribution on a flat plate with a laminar boundary layer in a conical hypersonic flow. Good agreement was obtained with measurements made in a longshot free-piston hypersonic wind tunnel using a nominal Mach number 15 conical nozzle of 6 deg half-angle. It was found that the surface pressure predicted using the present theory agreed better with experiment than the Lees and Probstein method using the local values of viscous interaction parameter x. This indicates that the effect of pressure gradient on the rate of boundary layer growth must be accounted for in hypersonic conical flows. The present theory was also used to study the effects of nitrogen condensation on flat plate surface pressure and heat transfer. The onset of nitrogen condensation in the longshot was found to occur under conditions similar to those found in other intermittent facilities.
Author (ESRO)

N71-13289# Fraunhofer Institut, Freiburg (West Germany).
THE COMPRESSED AIR GUN: CALCULATION AND EXPERIMENTS [DIE DRUCKLUFTKANONE: BERECHNUNG UND VERSUCHE]
R. Heiser Dec. 1969 56 p In GERMAN
(Rept-14-69) Avail: NTIS

Extensive tests were carried out to investigate the importance of the influence of several factors on the orifice velocity of a compressed gas gun. The results are compared with calculations. With compressed air a maximal orifice velocity is reached of 450 m/sec and with compressed helium, 530 m/sec.
ESRO

N71-13290# Fraunhofer Institut, Freiburg (West Germany).
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF SHOCK WAVE DIFFRACTION ON SPHERES AND CYLINDERS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUR BEUGUNG VON STOSSWELLEN AN KUGELN UND ZYLINDERN]
W. Heilig Jan. 1970 122 p refs In GERMAN
(Rept-2-70) Avail: NTIS

Whitham's theory of shock wave diffraction was tested with diffraction measurements on spheres and cylinders. Weak to moderately strong primary shocks were used with shock Mach numbers between 1.03 and 2.15, and use was made of shadowgraph photography.
ESRO

N71-13291# Fraunhofer Institut, Freiburg (West Germany).
INVESTIGATIONS OF THE PRESSURE DISTRIBUTION OVER AN END PLATE OF AN AIR-DRIVEN MEMBRANE SHOCK TUBE [UNTERSUCHUNGEN UEBER DEN DRUCKVERLAUF AN DER ENDPLATTE EINES LUFTBETRIEBENEN MEMBRAN-STOSSROHRES]
G. Guerke, H. Reichenbach, and G. Schwarzkopf Mar. 1970 40 p refs In GERMAN
(Rept-3-70) Avail: NTIS

The pressure distribution at the end plate of a shock tube was investigated experimentally and theoretically. The reason for these investigations is pressure elevation due to reflected waves at the medium boundary. This effect is disturbing for shock tubes used as shock pressure simulators.
ESRO

N71-13292# Fraunhofer Institut, Freiburg (West Germany).
INTERIOR BALLISTIC INVESTIGATIONS ON A LIGHT-GAS GUN [INNENBALLISTISCHE UNTERSUCHUNGEN AN DER LEICHT-GASKANONE]
A. Stilp, W. Merzkirch, H. Giesbrecht, H. Oezen, and U. Tamgac Dec. 1969 45 p refs In GERMAN
(Rept-13-69) Avail: NTIS

Experimental and theoretical investigations concerning the operation of a light-gas gun are described. Interior pressure measurements are carried out, using a piezoelectric transducer. The compression characteristics due to the piston movement are calculated. The results of both investigations are compared with regard to orifice velocity.
ESRO

N71-13313# California Univ., San Diego. La Jolla Dept. of the Aerospace and Mechanical Engineering Sciences.
RESEARCH ON TURBULENT FLOWS WITH CHEMICAL REACTIONS Final Report, 1966 – 1970
Paul A. Libby Sep. 1970 10 p refs
(Grant AF-AFOSR-0927-67)
(AD-712727; AFOSR-70-2483TR) Avail: NTIS CSCL 20/4

The progress made on the principal effort is discussed, namely that connected with the application of hot-wire anemometry and digital techniques for obtaining on a time and space resolved basis the velocity components and concentrations of constituents of highly turbulent multicomponent gaseous flows with significant density fluxuations. Related hot-wire research is discussed which was motivated by anomolous behavior observed during early hot-wire experiments in this project. In addition other work is discussed which is related fundamentally to turbulent flows in propulsive devices.
Author (TAB)

N71-13383# New Hampshire Univ., Durham. Engineering Design and Analysis Lab.
A DIGITAL FLUERIC COMPENSATOR FOR ANALOG FLUID SYSTEMS Final Report
Shahid Nawaz and Charles K. Taft 5 Nov. 1969 113 p refs
(Contract DAAG39-68-C-0028)
(AD-713026) Avail: NTIS CSCL 13/7

A digital pulse compensation technique is developed for analog control systems. The scheme employs pulse width modulation to convert analog error signals into discrete signals and compensation is achieved by adding one or more pulses to this discrete error signal. The digital compensation pulses are used directly as an input to the process, as no digital to analog conversion is required. A flueric compensator of this type is implemented and the experimentally measured performance is compared to analytically predicted behavior. Computer simulation is also used to verify compensator

performance. Design guides for compensator specifications and other analytical tools needed for analysis and synthesis are developed. Author (TAB)

N71-13388# National Physical Lab., Teddington (England). Ship Div.
AUTOMATED ANALYSIS OF WAVE PATTERNS BEHIND TOWED MODELS
N. Hogben Jun. 1970 30 p refs
(NPL-Ship-143) Copyright. Avail: NTIS

A prototype for a so-called matrix method of wave pattern analysis with application to a fully automated recording system has been developed comprising a stationary array of four capacitance probes with punched tape output and a computer program which analyses the tapes. A brief account of the system including a description of the computer program and some sample results is given. Author (ESRO)

N71-13398# Air Force Cambridge Research Labs., Bedford, Mass.
EXACT VORTICITY SOLUTIONS OF THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS
Harry E. Moses 30 Jul. 1970 22 p refs *Its* Phys. Sci. Res. Papers AFCRL-PSRP-423
(AD-712018; AFCRL-70-0421) Avail: NTIS CSCL 20/14

Turbulence is found in all regions of the atmosphere, where it plays an essential role in meteorology, affects flight characteristics of vehicles, and accounts for some of the erratic behaviour of the ionosphere. The report arose out of the attempt to see whether some of the properties of turbulence could be obtained from vorticity solutions of the Navier-Stokes equations, since it is generally assumed that these equations govern the motion of turbulent fluids. For simplicity, the fluid was taken to be incompressible and of infinite extent. Exact vorticity solutions were found, which in a sense are the simplest possible ones. They have much structure in space but they lack the time-fluctuations characteristic of turbulence. Despite the failure of these solutions to describe turbulent flow, they should be of interest because they can be added to the very short list of exact vorticity solutions of fluid dynamics, and are very different from the previously known ones. Author (TAB)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N71-12566*# National Aeronautics and Space Administration, Washington, D.C.
THIS ISLAND EARTH
Oran W. Nicks, ed. Oct. 1970 192 p
(NASA-SP-250) Avail: SOD $6.00; NTIS CSCL 08F

Photographs taken from satellites and manned spacecraft are presented and discussed in order that man may better understand his place in the universe. The emphasis is on the earth and its atmosphere, waters, lands, and man-made features. Detailed pictures are given of North American mountains, plains, and coasts. Photographs are also included of the sun, planets, and moon. N.E.N.

N71-12693# GCA Corp., Bedford, Mass
MECHANISMS FOR REMOVAL OF CARBON MONOXIDE FROM THE ATMOSPHERE Final Report
Jerome Pressman, I. M. Afin, and Peter Warneck Apr. 1970 45 p refs
(Contract PHS-CPA-22-69-36)
(PB-192188; GCA-TR-70-6-G) Avail: NTIS CSCL 13B

Three aspects are discussed: (a) the photochemical CO oxidation in the stratosphere; (b) reaction of CO with ozone in the troposphere; and (c) CO removal by oxidation in the hydrosphere. The mechanism of stratospheric CO removal is considered, and its significance as an atmospheric CO sink is discussed. An account is given of the reaction between CO and ozone and of CO oxidation in aqueous solutions. A summary is given of the conclusions drawn from these investigations with regard to atmospheric CO removal processes. Author (USGRDR)

N71-12694*# Translation Consultants, Ltd., Arlington, Va.
THE ELASTIC PARAMETERS OF ROCKS AT HIGH PRESSURE AND THE STRUCTURE OF THE KOLA PENINSULA GRANULITIC COMPLEX [OB UPRUGIKH PARAMETRAKH GORNYKH POROD PRI VYSOKIKH DAVLENIYAKH I STROYENII GRANULITOVOGO KOMPLEKSA KOLSKOGO POLUOSTROVA]
M. P. Volarovich et al Washington NASA Dec. 1970 23 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Ser. Geol. (USSR), no. 4, 1968 p 3–16
(Contract NASw-2038)
(NASA-TT-F-13393) Avail: NTIS CSCL 08G

Field data interpretation from geological and geophysical research in one region of the Baltic shield is presented. Rock types constituting specific layers of the earth's crust are described based on subsurface seismic probing and elastic wave velocity determinations in rock samples. Author

N71-12696# Communications Research Centre, Ottawa (Ontario).
ALOUETTE 2 IONOSPHERIC DATA N(h). VOLUME 1: NO. 1: ELECTRON NUMBER DENSITY VERSUS REAL HEIGHT TABULATIONS
[1970] 177 p ref Sponsored in part by ESSA, Radio and Space Res. Sta. of Gt. Brit., and NRC
Avail: NTIS

These tabulations consist of electron number density profiles for selected groups of ionograms obtained from the Alouette 2 topside sounder satellite. The profiles are listed in the order in which the ionograms are recorded. Spread F and other phenomena which complicate the ionograms limit the accuracy with which the electron number density profiles can be deduced. The suitability of an ionogram record for obtaining high accuracy data is indicated by a subjective quality figure, Q. This index has values from 4 for the best quality records to 9 for those ionographs which provide minimal information concerning the electron density distribution. Data with Q figures 7 to 9 should be used with caution. The assumption is made that the sounder echoes are received from vertically below the satellite; this is not always true. More than one set of reflections are often observed on the ionogram, leading occasionally to doubt as to the appropriate reflection trace to be used. On these occasions, the number density was computed from the reflection trace at the shorter apparent range, except when reflections from the earth were found to be associated with the longer range echoes. Author

N71-12730# Army Chemical Center, Edgewood, Md. Detection and Warning Lab.
SPECTRAL ABSORPTION CHARACTERISTICS OF THE MAJOR COMPONENTS OF DUST CLOUDS Technical Report, May 1968–Dec. 1969
Dennis F. Flanigan and Harry P. De Long Sep. 1970 47 p refs
(AD-712989; EA-TR-4430) Avail: NTIS CSCL 4/1

It is well known that dust clouds selectively absorb radiation in the 700 to 1300/cm atmospheric window region. Studies have shown that dust clouds are composed of the same minerals as surface soils, although in different proportion. Seventy soil samples were examined from a number of locations around the world to

determine their compositions and spectral characteristics. The results indicate that there are five major components that selectively absorb radiation in the 700 to 1300/cm region. These are three clay minerals, silica, and calcium carbonate. Absorptivity coefficient spectra of representative soil samples are given in the body of the report, and transmission spectra of all soil samples are given in the appendix. Author (TAB)

N71-12747*# Agence Tunisienne de Public-Relations, Tunis.
RESEARCH ON GEOTROPISM [UNTERSUCHUNGEN UEBER GEOTROPISMUS]
F. Czapek Washington NASA Dec. 1970 107 p refs Transl. into ENGLISH from Jahrb. fuer Wiss. Botan. (Germany), v. 27, 1895 p 243–339 Sponsored by NASA
(NASA-TT-F-1263; TT-70-58016) Avail: NTIS CSCL 06E

Results of research conducted on the sensitivity of plants to geotropism are presented. Special attention was paid to the relationship of geotropic processes and the self-direction of plant parts. Specific investigations dealt with: (1) geotropic sensitivity of root tips; (2) external influences on geotropic stimulus processes; and (3) dimension and course of geotropic stimulus action. A.L.

N71-12748*# Scripta Technica, Inc., Washington, D.C.
DETERMINATION OF SHORT-TERM VARIATIONS IN ATMOSPHERIC DENSITY FROM QUASI-SYNCHRONOUS VISUAL OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES [OPREDELENIYE KRATKOVREMENNYKH IZMENENIY PLOTNOSTI ATMOSFERY IZ KUAZICINXRONNYZ VIZUAL'NYKH NABLYUDENIY ISKUSSTVENNYKH SPUTNIKOV ZEMLI]
M. Ill NASA Dec. 1970 107 p refs Transl. into ENGLISH from Byull. Sta. Opt. Nablyudeniya Iskusstvennykh Sputnikov Zemli (Moscow), no. 53, Issue 1, 1969 p 9–22
(Contract NASw-2036)
(NASA-TT-F-13288) Avail: NTIS CSCL 04A

Results of short period atmospheric density variations determined from quasi-simultaneous visual observations of satellites are presented. The conclusiion is drawn that the period of the satellite can be determined with a precision of + or − 0.0001(m) and its variations with that of + or − 0.001(m) during one passage. Density variations with the amplitude of the order of 64.3% in two days interval were discovered for the satellite Cosmos-53. Author

N71-12749*# National Aeronautics and Space Administration, Washington, D.C.
RATE OF EROSION IN STRATO-VOLCANOES IN JAPAN
Takasuke Suzuki Dec. 1970 20 p refs Transl. into ENGLISH from Kazan (Tokyo), v. 14, no. 3, 1970 p 133–147
(NASA-TT-F-13345) Avail: NTIS CSCL 08M

The erosional features of volcanic cones are expressed in some quantitative indices and the relations between the indices and the duration of erosion are shown. All measurements to lead the indices are made by using topographic contour maps on the scale of 1:50,000. Thirty-four, monotonous, conical, isolated strato-volcanoes in Japan are selected for the measurements in order to eliminate various factors, other than age affecting the present state of erosion. Author

N71-12750# Israel Program for Scientific Translations, Ltd., Jerusalem.
LITHOLOGY AND GEOCHEMISTRY OF THE WEATHERING CRUST
K. I. Lukashev 1970 373 p refs Transl. into ENGLISH of the publ. Osnovy Litologii i Geokhimii Kory Vyvetrivaniya Minsk, Izd. AN BSSR, 1958 p 1–457 Sponsored by NSF and Dept. of Interior
(TT-69-55031) Copyright. Avail: NTIS CSCL 08G

The lithology and geochemistry of weathering crust is discussed. Subjects presented are: (1) development of weathering crust theory, (2) factors influencing weathering crust formation, (3) geochemical types and stages, (4) thermodynamics of weathering and migration of elements, (5) effect of mineral composition of rocks on weathering crust formation, and (6) effect of climate on weathering crust formation. USGRDR

N71-12757# Israel Program for Scientific Translations, Ltd., Jerusalem.
ON THE THEORY OF THE MEASUREMENT OF THE ATMOSPHERIC ELECTRIC FIELD [K TEORII IZMERENIYA NAPRYAZHENNOSTI ATMOSFERNOGO ELEKTRICHESKOGO POLYA]
H. F. Tammet 1970 13 p refs Transl. into ENGLISH from Tr. Po Aeroionizatsii i Elektroaerozolyam (Tartu), no. 3, Issue 240, 1970 p 140–154 Sponsored by NSF
(TT-70-50125; IPST-5858) Avail: NTIS CSCL 04/A

The three well-known, basic methods of measuring the atmospheric electric field are: the conductivity method (collector instruments), the induction method (the Wilson instrument), and the generator method (rotor and vibration field mills utilizing the principle of the electrostatic generator). An attempt is made to establish a theory of measurement of the electric field, based on a basic idea common to all methods. Author (USGRDR)

N71-12774*# California Univ., La Jolla.
PLASMA CLOUDS IN THE MAGNETOSPHERE
S. E. De Forest and C. E. McIlwain Sep. 1970 56 p
(Grant NGL-05-005-007)
(NASA-CR-111609; UCSD-SP-70-04) Avail: NTIS CSCL 20I

Equatorial observations by the geostationary satellite ATS-5 of the charged particles on auroral lines of force reveal the frequent injection of plasma clouds into the magnetosphere. These intrusions of hot plasma are found to have a one to one correspondence with magnetospheric substorms. The clouds are dispersed by the earth's magnetic and electric fields in a fashion which generates complicated energy structure. Author

N71-12775# Geological Survey, Washington, D.C.
GROUND WATER IN THE PERMAFROST REGIONS OF ALASKA
John R. Williams 1970 88 p refs /ts Geol. Surv. Profess. Paper No. 696
Avail: SOD $1.00

A nonmathematical summary of the origin and history of permafrost is presented. The factors that influence the local configuration of permafrost as an aid to understanding the effect of permafrost on recharge, discharge, movement, and storage of ground water in a given geologic environment are discussed. The material is presented in sections on each of the major geologic environments in the permafrost region. Author

N71-12864 National Lending Library for Science and Technology, Boston Spa (England).
CHANGES IN THE CARBON-DIOXIDE CONTENT OF THE ATMOSPHERE: A GLOBAL AIR POLLUTION PROBLEM
B. Bolin 29 May 1970 15 p Transl. into ENGLISH from Stat. Naturvetensk. Forskningsgr. (Stockholm), 1966 p 134–146
(NLL-M-9147-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The process by which man has changed the CO2 content in the atmosphere through geochemical processes is discussed. Also included in the discussion are the effects the CO2 changes have on the earth's radiation balance and its role as a climate regulating factor. E.H.W.

N71-12865# Spectrametrics, Inc., Burlington, Mass.
BALLOON BORNE POLAR NEPHELOMETER MEASUREMENTS OF THE ATMOSPHERE Final Report, 1 Jun. 1967–31 Dec. 1968

William G. Elliott 1 Feb. 1970 137 p refs
(Contract F19628-67-C-0412)
(AD-712091; SM-70-1; AFCRL-70-0084) Avail: NTIS CSCL 4/1

The report presents the results of a series of field measurements with a Balloon Borne Polar Nephelometer. This instrument measures the optical scattering from a defined volume of atmosphere through which the instrument is transported by a high altitude balloon. Measurements were made from ground level to an altitude of 90,000 feet. Parameters investigated include scattering angle, polarization, and wavelength. The report includes a brief description of the instrument and summaries for each flight made between November 1967 and November 1969. The optical scattering data is graphically presented in the form of volume scattering function versus altitude for each of the parameters investigated. Tables of the individual measurement values have been submitted separately for future detailed analysis. Author (TAB)

N71-12886 National Lending Library for Science and Technology, Boston Spa (England).

ON THE RECORDING OF DUST CONCENTRATIONS IN THE ATMOSPHERE

S. A. Konkov 29 May 1970 10 p refs Transl. into ENGLISH from Glav. Geof. Obs., Tr. Vyp. (Leningrad), v. 234, 1968 p 181–187
(NLL-M-9139-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Different methods and instruments were developed to measure the noxious impurities in the surface layer of the air. Comparisons are made of the errors and reliability of each method. Conclusions show the type of filter used and the calibration of the instrument are primary factors in causing the errors. Conclusions also indicate the NEL and the LFS type filters are superior to other types used in the tests. E.H.W.

N71-13030# Texas Univ., Austin. Electrical Engineering Research Lab.

THE CONTINUATION OF THE STUDY OF THE DETECTION OF MAGNETIC ANOMALIES BY MEANS OF THE PERTURBATIONS IN THE NATURAL GEOMAGNETIC FIELD Final Report, 1 Sep. 1968–31 Aug. 1970

H. W. Smith, F. X. Bostick, Jr., and B. C. Fowler Aug. 1970 17 p
(Contract Nonr-375(14))
(AD-712131) Avail: NTIS CSCL 17/6

The report presents a feasible method of detecting the passage of various metallic objects by means of perturbations in the natural geomagnetic field in the micropulsation frequency range (0.0001 to 10 Hz). Author (TAB)

N71-13032# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

DEVELOPMENT OF A NOZZLE BEAM CONTAINING ATOMIC OXYGEN

Calvin K. Lam Jul. 1970 49 p refs
(Grant DRB-G-9551-17)
(AD-710937; UTIAS-TN-153) Avail: NTIS CSCL 14/2

Initial studies of the feasibility of producing a hypersonic molecular beam containing appreciable amount of atomic oxygen have been successfully completed. The purpose of the work was to produce a molecular beam which could be used for basic and applied studies related to the interaction of the earth's upper atmosphere, such as accommodation coefficient measurements or surface reations at high kinetic energy. A quartz tube source was developed for the molecular beam in which a 200 watt microwave discharge could be maintained. The studies included the effect of pressure and orifice size, for which a compromise was involved in order to achieve high Mach numbers and high dissociation levels, the use of double cavities, and the effect of small additions of H2O. It was demonstrated in these initial tests that a hypersonic beam from a 92% He 8% O2 mixture could be produced with 17% dissociation. Author (TAB)

N71-13041# Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 239 28 Oct. 1970 p 32–45 (See N71-13038 03-34)
Avail: NTIS

News releases and abstracts are presented on the spreading of the ocean floor, ion content in growing ice, determining the concentration of suspended matter in sea water, seasonal fluctuation in the level of the South China Sea, and hydrological structure of the Atlantic Ocean waves. F.O.S

N71-13042# Joint Publications Research Service, Washington, D.C.

TERRESTRIAL GEOPHYSICS

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 239 28 Oct. 1970 p 46–56 (See N71-13038 03-34)
Avail: NTIS

News briefs and abstracts of articles are presented on seismology, gravity anomalies, polarity of early quaternary deposits, and measuring the depth of lakes from small-scale air photographs. F.O.S.

N71-13052*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.

ENIGMAS IN ASSESSING THE COMPOSITION OF A ROCK UNIT: A CASE HISTORY BASED ON THE MALSBURG GRANITE, SOUTHWEST GERMANY

E. H. Timothy Whitten 31 Jul. 1970 49 p refs
(Grants NGR-14-007-027; NSF G-19633)
(NASA-CR-111569; Rept-23) Avail: NTIS CSCL 08G

Methods for correctly assessing the three dimensional composition and variability of rock formations are discussed. New analyses for 10 major oxides are presented for 37 localities. The autocorrelation of residuals from polynomial trend surfaces based on 110 alkali analyses are explained by factors other than significant local geological variability. The assemblage of independent sets of analyses permits evaluation of the sampling problems and the different methods of assessing the three dimensional variability of granite masses. Previously published zonal maps are tested with discriminant analysis. It is concluded that Q-mode factor analysis maps provide the best available method for mapping zones in granite. Author

N71-13075# Melbourne Univ., Parkville (Australia). Dept. of Physics.

STABILIZED GONDOLA ENGINEERING FLIGHTS

J. A. Thomas 1970 5 p
(NYO-3747-13) Avail: NTIS

For astronomical, atmospheric, and terrestrial observations from balloon-borne platforms it is desirable to maintain the gondola (or portion of its load) in a stable orientation. For this purpose an azimuthal gondola orientation system was developed and successfully test flown. Author

N71-13086*# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.

ANALYSIS OF LATITUDE OBSERVATIONS FOR DETECTION OF CRUSTAL MOVEMENTS

M. G. Arur Jun. 1970 102 p refs Supported in part by the UN
(Contract NGR-36-008-093; OSURF Proj. 2514)
(NASA-CR-111567; Rept-139) Avail: NTIS CSCL 08E

The analysis of published data of a latitude station to find evidence of sudden short term changes in latitude at the station and thus to determine movements of the earth crust is discussed. Astronomic latitude observation at a station at any epoch yields the complement of the angular distance between the local vertical

and the instantaneous rotation axis of the earth. Variations in the values of the latitude at a station, as reduced from daily observations, can determine the local crustal displacement of the station position with respect to the earth's crust and changes in the direction of the vertical at the station. Author

N71-13087*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEASONAL SEA SURFACE TEMPERATURE VARIATIONS IN THE PERSIAN GULF AS RECORDED BY NIMBUS 2 HRIR
K.-H. Szekielda, V. Salomonson, and L. J. Allison Nov. 1970 18 p refs Submitted for publication
(NASA-TM-X-65385; X-651-70-416) Avail: NTIS CSCL 08C

Nimbus 2 high resolution infrared radiometer observations over the Persian Gulf were analyzed for cloud-free nights from June to November 1966. The relative spatial and temporal distribution of the observed mean equivalent blackbody temperature data is in agreement with historical seasonal surface ship data. The sea surface temperature spatial distribution as observed by the satellite radiometer was seen to respond to the prevailing surface winds. These results show that satellite radiometric observations can be used to discover large scale air-sea interaction features. Author

N71-13088*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DEVELOPMENT OF UPWELLING ALONG THE SOMALI COAST AS DETECTED WITH THE NIMBUS 2 AND NIMBUS 3 SATELLITES
Karl-Heinz Szekielda Sep. 1970 56 p refs Submitted for publication
(NASA-TM-X-65387; X-651-70-419) Avail: NTIS CSCL 08C

The ground truth of remote-sensed equivalent blackbody temperature T sub BB for the Persian Gulf as determined from Nimbus 2 satellite data was investigated. The T sub BB values recorded with the high resolution infrared radiometer in this region were 0.1 C cooler than the reported ship temperatures. The standard deviation from the difference between T sub BB values and ship measurements was 1.29, indicating that over cloud-free regions very good accuracy from orbiting sensors can be obtained. The T sub BB recordings along the Somali coast showed the development of upwelled water between May 23 and June 8, 1966. The T sub BB analysis from July 3, 4, and 6 disclosed a very complicated structure near the coast, which can be explained by cyclonic and anticyclonic gyres. The temperature structure was confirmed by conventional ship data. The coldest temperatures were found on July 16 at 10 N near the coast with temperatures below 15 C. A very strong thermal gradient appears during the upwelling period between the Gulf of Aden and the adjacent sea. This indicates that the gulf has a separate surface circulation. Author

N71-13089*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
THE MEASUREMENT OF ATMOSPHERIC OZONE USING SATELLITE INFRARED OBSERVATIONS IN THE 9.6 MICRON BAND
James Madison Russell, III (Ph.D. Thesis) Jul. 1970 180 p refs
(Contracts NSR-23-005-376; NASr-54(03); Grants NGR-23-005-394; ESSA-E92-69-N)
(NASA-CR-111566; Rept-03635-1-T) Avail: NTIS CSCL 04A

Two approaches to the measurement of ozone from a satellite using the 9.6 micron m band are analyzed; the nadir experiment and the horizon experiment. First, a technique is developed for inverting radiances measured in the nadir direction. A method is formulated for computing the emission from the lower boundary under the satellite which circumvents the difficult analytical problems caused by the presence of atmospheric clouds and the water vapor continuum absorption. The inversion equations are expanded in terms of the eigenvectors and eigenvalues of a least squares solution matrix and an analysis is performed to determine the information content of the radiance measurements. Next, a method is developed for inverting radiances measured in the horizon direction. The ensuing study proves the feasibility of the horizon experiment for determining ozone information and shows that the ozone partial pressure can be determined in the altitude range from 50 km down to 25 or 30 km. Author

N71-13090*# Woods Hole Oceanographic Institution, Mass.
THE COLOR OF THE OCEAN Report of the Conference, Aug. 1969
William I. Thompson, III, comp. (NASA, Flight Res. Center) [1969] 135 p refs Conf. held at Woods Hole, Mass., 5–6 Aug. 1969; sponsored by NASA
(Contract NAS12-163)
(NASA-CR-111570) Avail: NTIS CSCL 08J

Presentations at a conference concerning the use of spectrophotometry and photography as an aid in aerial and satellite reconnaissance of the ocean to locate distinct water masses and areas of high biological productivity are given. Topics considered include: (1) upwelling radiance of the ocean with special reference to color; (2) applications to physical oceanography and to biological problems including primary productivity, fisheries, pollution, currents, and bottom studies; (3) the physical basis of upward radiance, scattering and absorption in the sea; and (4) instrumentation, data reduction, and interpretation. D.L.G.

N71-13091# Catholic Univ., Santiago (Chile). Inst. of Astrophysics.
SOME DISCOVERIES IN SEISMOLOGY AND GEOMAGNETISM. 2. APPENDIX: METHODS AND RESULTS OF 30 YEARS OF RESEARCH
Francis Gun-Bayer 1970 32 p refs
Avail: NTIS

An overview is presented on the significance of data relating to geomagnetic unrest obtained over a thirty year period. Monthly and yearly charts are given illustrating recorded pulsation curves, and discussions are made concerning the connection between these data and other geophysical phenomena. D.L.G.

N71-13094*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
STATISTICAL EVALUATION OF THE COMPOSITION, PHYSICAL PROPERTIES, AND SURFACE CONFIGURATION OF TERRESTRIAL TEST SITES AND THEIR CORRELATION WITH REMOTELY SENSED DATA Final Report
E. H. Timothy Whitten and Walter A. Beckman, Jr. 7 Oct. 1970 21 p refs
(Grant NGR-14-007-027)
(NASA-CR-111568; Rept-24) Avail: NTIS CSCL 08G

A review of the project is presented which includes a list of reports issued, published articles, and statistical methods used in the remote-sensing program. The work, utilizing spatial filtering for analyzing the structural configuration of the top of the Dundee Limestone in the Michigan Basin is described. Maps prepared by polynomial, Fourier series, and filtered structural contours from numerical analysis of two different sets of data are shown. F.O.S

N71-13095# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia). Geological Branch.
BIBLIOGRAPHY OF REPORTS ON GEOLOGY, GEOMORPHOLOGY AND GLACIAL GEOLOGY RESULTING FROM AUSTRALIAN WORK IN ANTARCTICA
I. R. McLeod 1970 11 p refs
(Rept-146) Avail: NTIS

This bibliography lists reports arising from Australian work in Antarctica and the sub-Antarctic islands in the fields of general geology, geomorphology, glacial geology, and marine geology. It

includes reports by workers from Australian organizations who were given some support by another nation, e.g. space on an oceanographic vessel, but whose work was not guided by or under the auspices of that nation. The list includes those published and unpublished reports issued or in press by the end of May 1970.
Author

N71-13125# North Carolina Univ., Chapel Hill. Dept. of Environmental Science and Engineering.
CHEMICAL AND ENVIRONMENTAL FACTORS AFFECTING OZONE CONCENTRATION IN THE LOWER TROPOSPHERE
Lyman A. Ribberton and James J. B. Worth (Res. Triangle Inst.) Aug. 1969 64 p refs
(Grant NSF GA-1022)
(ESE-Publ-234) Avail: NTIS

Chemical and environmental factors affecting the ozone concentration in the lower troposphere are discussed. Conclusions resulting from the study are: (1) measurement of ozone concentration provides a good means of determining vertical motion of the atmosphere, (2) ozone concentrations frequently increase ahead of a cold front, (3) ozone synthesis can occur in the troposphere, and (4) the behavior of ozone in the lower troposphere is dependent upon both physical and chemical factors and is strongly influenced by the underlying surface. Author

N71-13158 Kodaikanal Observatory (India).
SOLAR LIMB GRADIENT FROM ECLIPSE SPECTRA OF 15 FEBRUARY 1961
Aleksandar Kubicela 1970 10 p refs *Its* Bull., Ser. A, No. 188
Copyright. Avail: Issuing Activity

During the total solar eclipse of February 15, 1961 two spectrograms were obtained at the moments of second and third contact of the eclipse. The spectrograms contain a smooth transition of the photospheric spectrum into the chromospheric and vice versa. Continual registration was achieved by means of a moving plate combined with a slit spectrograph. The method adopted and a description of the spectrograph and the chromospheric spectrophotometric results obtained were previously published. The 1961 eclipse data are used to find the intensity of solar continuum radiation dependent on heliocentric heights within the last second of apparent solar radius. Author

N71-13159# Weapons Research Establishment, Salisbury (Australia).
ANOMALOUS UPPER ATMOSPHERE PARAMETERS DERIVED FROM TWO AERO-HIGH ROCKET FIRINGS
K. H. Lloyd and C. H. Low Jul. 1970 26 p refs
(WRE-TN-HSA-175) Avail: NTIS

This note presents observations made on glow clouds produced by the release of aluminised grenades from two Aero-High upper atmosphere sounding rockets fired at Woomera, South Australia. The large release from one of the rockets produced a rapidly expanding 'halo', which is examined in detail. The atmospheric parameters derived from the observations on the releases show some curious anomalies. Explanations for these are discussed. Author

N71-13170# Texas A&M Univ., College Station. Dept. of Oceanography.
OCEANOGRAPHY IN THE GULF OF MEXICO Final Report, 1 May 1961 – 15 Dec. 1969
Richard A. Geyer Sep. 1970 25 p refs
(Contract Nonr-2119(04))
(AD-712782; A/M-Ref-70-14F) Avail: NTIS CSCL 8/10

The report gives a summary of oceanographic research in the Gulf of Mexico supported by the Office of Naval Research during the period 1 May 1961 - 15 December 1969. This research involved theoretical studies in ocean dynamics; currents in the Gulf of Mexico, Cayman Sea, western tropical Atlantic and eastern tropical Pacific; development of geostrophic eddies and associated turbulence phenomena; bio-environmental studies; geophysical research; geotechnical properties; chemistry and air-sea interaction.
Author (TAB)

N71-13171# Hydronautics, Inc., Laurel, Md.
STUDIES OF HIGH FREQUENCY WIND WAVES
Jin Wu Oct. 1969 44 p refs
(Contracts Nonr-3688(00); N00014-70-C-0345)
(AD-712787; TR-231-26) Avail: NTIS CSCL 8/3

The microstructure of the wind-disturbed water surface, characterized by surface-slope and surface-curvature distributions is studied with a newly-developed optical instrument. The measurements show systematically some features of these distributions under various wind conditions, and are correlated with the results of airflow boundary-layer surveys. Two regimes of equilibrium with different mechanisms for limiting wave growth are also discussed. In addition, with a turbulent wind, the present laboratory results exhibit variation of the mean square slope with the shear velocity similar to older oceanic data, suggesting possibility of the laboratory simulation of the microstructure of the air-sea interface. Author (TAB)

N71-13175# Hydronautics, Inc., Laurel, Md.
ON WIND WAVE INTERACTIONS
Jin Wu Nov. 1969 20 p refs
(Contracts Nonr-3688(00); N00014-70-C-0345)
(AD-712788; TR-231-27) Avail: NTIS CSCL 4/2

A criterion proposed earlier for determining air-flow separation from wind waves and a previously determined relationship between surface roughness and wind stress are herein correlated. The results indicate that the airflow boundary layer is developed due to the form drag provided by wavelets (surface roughness) superimposed on big waves. Based on the magnitudes of surface roughness, viscous-sublayer thickness and critical height, the mechanisms of wind-wave generation are discussed. Author (TAB)

N71-13191# Hydronautics, Inc., Laurel, Md.
SURFACE ROUGHNESS, SEA-SURFACE SLOPE AND WIND-WAVE SPECTRUM
Jin Wu Jan. 1970 26 p refs
(Contracts Nonr-3688(00); N00014-70-C-0345)
(AD-712790; TR-231-29) Avail: NTIS CSCL 8/3

The mean square slope of the sea surface is shown to vary logarithmically with the wind velocity, and the rate of variation changes with different boundary-layer regimes of the wind. Based on mean square slope data, the spectra constant of the directional wind-wave spectrum in the equilibrium range is seen to vary with wind regimes. An approximate correlation is presented between the mean square slope and the roughness height of the sea surface.
Author (TAB)

N71-13192# Bureau of Commercial Fisheries, Seattle, Wash. Biological Lab.
PHYSICAL-CHEMICAL OCEANOGRAPHIC DATA FROM THE NORTH PACIFIC OCEAN, 1966–1968
W. James Ingraham, Jr. and Donald M. Fish Jun. 1970 683 p refs
(PB-193240; XFDR-B-48-1-682-(1970); FWS-DR-48) Avail: NTIS CSCL 08J

Temperature and salinity data collected in the central and northeastern Pacific Ocean are presented. These data were compiled from 156 Nansen bottle casts and 494 STD casts.
Author (USGRDR)

N71-13229# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Abteilung fuer Weltraumphysik.
RESEARCH ON THE POLAR IONOSPHERE WITH

HF-SIGNALS OF ARTIFICIAL SATELLITES [UNTERSUCHUNG DER POLAREN IONOSPHAERE MIT HF-SIGNALEN KUENSTLICHER SATELLITEN]

J. Oksman (Oulu Univ.) and J. P. Schoedel Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1970 46 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.

(BMBW-FB-W-70-39) Avail: NTIS; ZLDI Munich: 9,70 DM

Polar ionosphere observations made by the beacon satellite Explorer 22 are discussed. Faraday rotation measurements are used to determine the electron content of the ionosphere. A considerable scatter of these values is observed. Nevertheless, an attempt is made to get mean values and daily variations of the electron content. Longtime variations are demonstrated. Very often scintillations obscure the field strength records. The phenomenology of the scintillations, especially of their southern boundary, is examined. It can be shown that this boundary moves southward with increasing solar activity. Furthermore an extension to the south is found if the geomagnetic activity increases. A relation to low energy electrons within the magnetosphere is suggested. Author (ESRO)

N71-13230# Kiruna Geophysical Observatory (Sweden).

CALCULATIONS OF ELECTRON CONTENT VARIATIONS DUE TO THE PASSAGE OF GRAVITY WAVES

Ludwik Liszka Mar. 1970 15 p refs

(KGO-702) Avail: NTIS

Variations in the electron content, due to passage of a gravity wave, as observed by means of a beacon satellite, are strongly dependent on the geometrical configuration of the satellite orbit, magnetic field lines, and the wave vector. Thus, observations may be interpreted assuming a single frequency disturbance. There would seem to be also a difference between variations produced by upward and downward propagating waves. It is therefore, in principle, possible to determine parameters of the wave from electron content variations produced by it. Due to the geometrical configuration, at medium and high northern latitudes most of the variations in n sub t will be visible to the south of the observer. This must be taken into account in studies of geographical distribution of travelling ionospheric disturbances observed by the electron content method. Due to the spatial structure of the disturbance, in particular in the presence of horizontal gradients, results obtained by simple triangulation using electron content observations will be very uncertain. However, a comparison of observations made at spaced stations with model calculations as proposed in the present paper should give reliable wave parameters. Author (ESRO)

N71-13231# Institut d'Aeronomie Spatiale de Belgique, Brussels.

HELIUM AND HYDROGEN DISTRIBUTIONS IN THE UPPER ATMOSPHERE

G. Kockarts 1970 28 p refs Presented at the Intern. School of Atmospheric Phys., Erice, Italy, 15-29 Jun. 1970 *Its* Aeronomica Acta A-76-1970

Avail: NTIS

The physical processes involved in the computation of helium and hydrogen distributions are described for steady state conditions. A solution of the general transport equation is given to indicate the effects of molecular and eddy diffusion. The concept of maximum transport velocity is introduced in relation with the initial distribution prevailing around 100 km altitude. The effect of eddy diffusion is particularly important for the helium distribution. Variations of a factor of 4 in the helium concentration at high altitude can be explained by a change of factor of 10 for the eddy diffusion coefficient in the 100 km region. Author (ESRO)

N71-13238# California Univ., San Diego.

RADAR SCATTERING FROM TURBULENT PLASMAS Final Report

Robert Abney 1969 56 p refs

(Contract DAHC04-67-C-0060; ARPA-Order-1009)

(AD-713000) Avail: NTIS CSCL 4/1

The document reports radio star scintillation observations which were carried out at the Jicamarca Radio Observatory during the period February - August, 1968. After an initial period of equipment set up and testing, observations were conducted whenever time was available at the Jicamarca facility. Electron density irregularities embedded in the electrojet were observed by Balsley (1967) to exhibit certain turbulence like characteristics. Those observations were based on radar backscatter measurements. The radar measurements indicated the presence of large scale (approximately 1 kilometer) irregularities with which the backscattering irregularities were associated. Accordingly, it was thought that forward scatter observations such as radio star scintillation measurements would allow a useful and independent observation of the turbulent irregularities. Author (TAB)

N71-13242# Stanford Research Inst., Menlo Park, Calif.

INVESTIGATION OF PKP SEISMIC WAVES Final Report

William F. Isherwood Sep. 1970 43 p refs

(Contract F44620-67-C-0080; ARPA Order 292)

AD-712731; AFOSR-70-2469TR) Avail: NTIS CSCL 17/10

A four-element seismic array was established at Byrd Station, Antarctica, for investigation of PKP seismic waves. This seismic station (BYA) has been operating continuously since January 18, 1968. Seismic data are recorded on magnetic tape at a level permitting playback at a system magnification of as high as 500,000. Background ground motion amplitudes at Byrd Station were found to be in the order of 10 millimicrons at the center seismometer when heavy equipment was operating, nearby. About 2,700 compressional and shear arrivals were reported in the first 8 months of recording, with epicenters ranging over the entire earth. About 400 of these events have been confirmed as PKP arrivals. The epicentral distance for these arrivals ranged from 110 to 173 degrees, with the majority being from the Japanese and Kurile areas. Data from the first full year of operation are now being processed at SRI. The station was turned over to the USC and GS and is currently being operated by that agency. Author (TAB)

N71-13273# Kiruna Geophysical Observatory (Sweden).

KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 69/7 9, JULY-SEPTEMBER 1969

L. Liszka ed. [1970] 117 p

Avail: NTIS

Results of ground-based measurements of upper atmosphere variables made at Kiruna, Sweden, are listed for July to September 1969. Recorded data include K indices, magnetic pulsations, standard magnetograms, and ionospheric absorption. ESRO

N71-13287# Tubingen Univ. (West Germany). Inst. of Astronomy.

THE ELECTRICAL FIELD IN THE FREE ATMOSPHERE Final Report [DAS ELEKTRISCHE FELD IN DER FREIEN ATMOSPHAERE Abschlussbericht]

Richard Muehleisen and Heinz-Juergen Fischer May 1968 60 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung

(FR-2) Avail: NTIS

From about 400 air electric radiosonde ascents the characteristic results of field strength measurements were elaborated. The different features in the field as a function of altitude are especially affected by the meteorological parameters. Therefore the results are divided into different weather types: fine and cloudless, clouds without precipitation, dust and fog, rain, snowfall, and thunderstorms. ESRO

N71-13288# European Space Research and Technology Center, Noordwijk (Netherlands).

THE INFLUENCE OF INFRARED ABSORPTION ON THE MEASUREMENT OF SIMULATED SOLAR RADIATION

G. Saenger and W. A. Shickle Paris ESRO Sep. 1968 45 p refs

(ESRO-TN-94-ESTEC) Avail: NTIS

The solar radiation lamps used for the heat balance tests made on spacecraft are normally calibrated in air. When the test chamber is evacuated, however, the spectrum and intensity of the radiation impinging on the spacecraft will have altered slightly, since there will no longer be any absorption due to atmospheric gases. An attempt has been made to estimate the effect that this reduction in absorption will have on the results obtained with various sensors employed in the test chamber, attention being paid mainly to the effects attributable to the presence or absence of water vapor and carbon dioxide. Author (ESRO)

N71-13293# Bergen Univ. (Norway). Dept. of Physics.

X-RAY AND PARTICLE RADIATION AT HIGH ALTITUDES IN THE AURORAL ZONE Final Progress Report, 1 Jul. 1969 -30 Jun. 1970

Harald Trefall Sep. 1970 6 p

(Contract AF 61(052)-869)

(AD-712726; AFOSR-70-2402TR) Avail: NTIS CSCL 4/1

A summary of field work, analysis of data and other related activities is given for the period 1 July 1969 - 30 June 1970. Fifteen balloons with payloads for the recording of auroral zone x-ray events were launched from Andenes during July and August 1969. The recordings are being analyzed. The plans for 1970-71 are outlined. Author (TAB)

N71-13311# Liege Univ. (Belgium). Inst. d'Astrophysique.

AN ON-BOARD POLYCHROMATOR FOR AURORAL STUDIES IN THE VISIBLE AND FAR UV DOMAINS [UN POLYCHROMATEUR EMBARQUABLE DESTINE AUX ETUDES AURORALES DANS LES DOMAINES VISIBLE ET UV LOINTAIN]

Robert Duysinx and Claude Jamar Paris ESRO Mar. 1970 29 p refs In FRENCH; ENGLISH summary

(ESRO-SN-111) Avail: NTIS

Spectroscopic studies of northern aurorae conducted from sounding rockets are made difficult by the fluctuating character of the light emission and the rocket motion. The use of several photometers, supplying continuous records of simultaneous emissions, allows precise correlations to be established, and helps unravel the dynamics of the mechanisms involved. The equipment comprised six photomultipliers working with a common dispersive unit so ensuring an identical viewing angle for all six detectors. Author (ESRO)

N71-13312# Tubingen Univ. (West Germany). Inst. of Astronomy.

THUNDERSTORM ELECTRICITY Final Report [STUDIEN ZUR GEWITTERELEKTRIZITAET Abschlussbericht]

Richard Muehleisen and Heinz-Juergen Fischer Dec. 1968 70 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung

(FR-4) Avail: NTIS

The results of measurements of various air-electric parameters in the near and far range of a thunderstorm cell are reported. The data were obtained during numerous thunderstorms in the vicinity of Lake Constance between 1966 and 1968. The parameters were the air electric potential gradient and its fast fluctuation, the point discharge, and the electric charges in the thunderclouds derived from the first values. Records of atmospherics were investigated with regard to the value of information about the distance of the lightning sources and about the activity of thunderstorm cells. ESRO

N71-13324# Institute for Storm Research, Inc., Houston, Tex.

A SYSTEM OF PREDICTING WAVES AND SWELLS ON THE US CONTINENTAL SHELF OF THE EAST COAST Final Report

John C. Freeman, Keith W. Veigas, Sam B. Rosenburg, and Walter Freeman Apr. 1970 12 p refs

(Contract EDA-41-USC-252-C(3))

(PB-192201; ISR-0-10) Avail: NTIS CSCL 08C

A method for computing waves for a given location along a continental shelf is outlined. Waves are computed at intervals along a line perpendicular to coastal depth contours; these depths range from 600 to 50 feet. This general procedure is valid for coastal waters along the eastern seaboard. It is not designed for estuaries and bays. In addition to locally generated waves, waves and swells, from the ESSA Weather Bureau deep water prediction program, for nearby grid points are considered. Author (USGRDR)

N71-13325# Coast Guard, Washington, D.C.

OCEANOGRAPHY OF THE WEDDELL SEA IN 1969 (IWSOE) Oceanographic Report, No. 31, Feb. -Mar. 1969

Gary L. Hufford and James M. Seabrooke Feb. 1970 38 p refs

(PB-192289; CG-373-31) Avail: NTIS CSCL 08J

The physical oceanography of the Weddell Sea during the austral summer of 1969 is discussed. The work was done on the icebreaker USCGC GLACIER (WAGB-4) as part of the second phase of the International Weddell Sea Oceanographic Expedition. Temperature, salinity, and oxygen measurements were obtained from a salinity-temperature-depth recorder and from Nansen bottles. Author (USGRDR)

N71-13326# Geological Survey, Denver, Colo.

SEISMIC REFRACTION SURVEY AT THE UNa SITE, NEVADA TEST SITE, NYE COUNTY, NEVADA

R. M. Hazlewood 1970 10 p

(USGS-474-76; NTS-226) Avail: NTIS

A seismic refraction survey was made by the U. S. Geological Survey at the UNa site, Nevada Test Site. The results of the survey were successful in determining velocities and the depth to bedrock. There is a near-surface velocity of 3,000 feet per second and intermediate velocity of 5,500 feet per second. Bedrock velocity is 11,000 feet per second with depths ranging from 170 to 219 feet. Author (NSA)

N71-13327# Coast Guard, Washington, D.C. Oceanographic Unit.

OCEANOGRAPHIC OBSERVATIONS, 1964-1968 NORTH ATLANTIC STANDARD MONITORING SECTIONS

David M. Husby Oct. 1969 203 p refs

(PB-192290; USCG-373-32; Rept-32) Avail: NTIS CSCL 08J

In November 1964, the USCGC MENDOTA (WHEC 69) occupied a line of oceanographic stations from the eastern Grand Banks to the southeast across the main core of the Labrador Current. This was the beginning of the U.S. Coast Guard's standard section monitoring program in the North Atlantic. It has long been recognized that our knowledge of large-scale variations in oceanic circulation, e.g., eddy processes, is very limited. Large-scale problems such as this need a large volume of long-term observations for their solution. In fulfillment of this objective, the U.S. Coast Guard initiated a program to provide for the systematic collection, compilation, and presentation of oceanographic data in the major current systems of the western North Atlantic. Seven sections in the North Atlantic were selected to be monitored by U.S. Coast Guard ocean station vessels. Author (USGRDR)

N71-13328# Naval Postgraduate School, Monterey, Calif.

CALCULATED AND OBSERVED CHANGES IN SEA SURFACE TEMPERATURE ASSOCIATED WITH HURRICANE PASSAGE

Jack James Jensen (M.S. Thesis) Sep. 1970 56 p refs

(AD-713052) Avail: NTIS CSCL 8/10

Analyses were made of the sea surface temperatures in the Gulf of Mexico in August for the four years 1965 through 1968. No one pattern was found to predominate. The subsurface temperature profiles were then considered, and a rate of simulated withdrawal of 4000 calories of heat per day was made, until there

was no heat in excess of 26C. This withdrawal represented heat removed during passage of a hurricane. Difference analyses were constructed for the initial sea surface temperature at each station and that after twenty-four hours of simulated withdrawal. The differences ranged from less than one degree to over fur degrees. Again, no consistent pattern was found but generally areas of high concentrations of heat experienced smaller decreases. Actual sea surface temperatures collected after two hurricanes were then analyzed and compared to temperature patterns predicted by the computer model. Illustrations of the relative availability of sensible heat energy for different sea surface temperatures are presented and a hypothesis made to account for the greater than average intensities of Hurricane Betsy (1965) and Camille (1969).
Author (TAB)

N71-13343# Bureau of Sport Fisheries and Wildlife, Jarraganett, R.I. Marine Game Fish Research Lab.
RESEARCH IN THE CENTRAL AMERICAN SEA. ISSUE NO. 1: DATA COLLECTED DURING THE SOVIET-CUBAN MARINE RESEARCH CRUISE
V. V. Rossov et al Mar. 1970 138 p refs Transl. into ENGLISH of the book "Issledovaniya Tsentralno-Amerikanskikh Morei, Vypusk 1: Po Materialam Sovetsko-Kubinskoi Morskoi Ekspeditsii" Kiev, Naukova Dumka Press, 1966 251 p Prepared by Fisheries Res. Board of Can. for Bur. of Sport Fisheries and Wildlife, Narragansett, R.I. *Its* Transl. Ser. No 931
(PB-189697T) Avail: NTIS CSCL 08A

Briefly discussed are: hydrological research of the Soviet-Cuban expedition; system of currents in the central American seas; new data on the geology of the Gulf of Mexico and the Caribbean seas; primary productivity of Cuban coastal waters; qualitative and quantitative characteristics of zooplankton of the Cuban Bench; data on phytoplankton of the Gulf of Mexico and Florida Strait; preliminary data on zooplankton of the eastern part of the Gulf of Mexico and the Florida Strait; preliminary results of Soviet research on zooplankton and its luminescence in the eastern Caribbean; distribution of pelagic roe and larvae of fish in Cuban waters.
USGRDR

N71-13356# European Space Research Organization, Paris (France).
SUBSTORM EVENTS
J. Ortner and A. F. Moore, eds. Sep. 1969 128 p refs Presented at ESRO Colloq., Kiruna, Sweden, Mar. 1969
(ESRO-SP-38) Avail: NTIS

Magnetospheric substorms, polar magnetic substorms, and the substorm aspects of magnetic pulsations and of auroral absorption and other effects of the upper part of the auroral particle spectrum are reviewed. Discussions concerning the following topics are presented; optical, magnetic, magnetic pulsation, VLF emission, absorption, auroral ionization drift, and auroral backscatter measurements on the ground; balloon measurements of electron precipitation; optical measurements with rockets; rocket and satellite measurements of electric fields and high latitud particle precipitation and Langmuir probe plasma measurements. Early results obtained with the ESRO 1/Aurorae satellite are discussed and details are given of the ESRO geostationary satellite project. Reports made by working groups on the distribution of ground stations, the geostationary satellite and other magnetospheric satellite projects, auroral absorption substorms, special events and the dynamics of the polar region are also given.
Author

N71-13357# European Space Research Organization, Paris (France). Space Missions Div.
THE ESRO PROGRAMME OF AURORAL SUBSTORM INVESTIGATIONS
J. Ortner *In its* Substorm Events Sep. 1969 p 7–8 (See N71-13356 03-13)
Avail: NTIS

Auroral data obtained on ESRO 1, ESRO 2, and HEOS A satellites are briefly described, and future plans are outlined. It is felt that significant results include the following: electric field measurements in the ionosphere, energy spectra of auroral particles, auroral emission data in the ultraviolet region, and ion and electron distributions and temperatures in the ionosphere. Plans include the launchings of a second flight model of ESRO 1, Azur, ESRO 4, and a geostationary satellite place on the conjugate point to the northern Scandinavian observatories.
N.E.N.

N71-13358# Alaska Univ., College. Geophysical Inst.
AN OUTLINE FOR FUTURE STUDIES OF MAGNETOSPHERIC SUBSTORMS
Syun-Ichi Akasofu *In* ESRO Substorm Events Sep. 1969 p 11–20 refs (See N71-13356 03-13)
(Grant NSF GA-1661)
Avail: NTIS

Successive magnetospheric substorms are a basic phenomenon during the main phase of magetospheric storms and they also manifest themselves in auroral, X-ray, ionospheric, proton aurora, and polar magnetic substorms. From the distribution of the magnetic disturbance vectors over the earth's surface, a three-dimensional electric current was deduced. The electric fields which could give rise to such a current system are discussed and their connection with the electron and proton distributions in the magnetosphere is investigated. It is suggested that an outwardly-directed electric field should exist in the evening sector and an inward electric field should exist in the morning sector. The storage and explosive release of energy and its conversion into substorm energy are discussed in detail and further investigation of the asymmetric proton belt is shown to be important. A closely-spaced east-west chain of auroral stations linked to an analysis center is now required for further studies of the auroral electrojet.
Author

N71-13359# Kiruna Geophysical Observatory (Sweden).
POLAR MAGNETIC SUBSTORMS
B. Hultqvist *In* ESRO Substorm Events Sep. 1969 p 21–39 refs (See N71-13356 03-13)
Avail: NTIS

The IGY and satellite data show that an electric jet current flows westward along the auroral oval rather than along the auroral zone and produces a negative bay close to the auroral oval. It had been assumed that return currents were responsible for the positive bays observed on the evening side of the earth, but recent satellite measurements support a two-cell current system. The DP 1 and DP 2 equivalent current systems are described and discussed. In auroral zone latitudes the currents giving rise to bays flow in the direction of elongated auroral forms but in the polar cap regions the currents flow 30–60 deg away from the auroral arc directions and more experiments are required to resolve this apparent discrepancy. Recently field-aligned currents were invoked to account for some auroral phenomena and the effect of such currents on magnetosphere models is considered. The dynamics of polar magnetic substorms, including break-up, westward travelling surges, and auroral oval dimensions, are discussed in detail. The role of the southward component of the interplanetary field in DP 1 and DP 2 variations is also considered as well as the magnetic effects in the magnetospheric tail that are associated with polar magnetic substorms.
Author

N71-13360# Groupe de Recherches Ionospheriques, Paris (France).
SUBSTORM ASPECTS OF MAGNETIC PULSATIONS
R. Gendrin *In* ESRO Substorm Events Sep. 1969 p 41–43 (See N71-13356 03-13)
Avail: NTIS

Geomagnetic micropulsations can be divided into types which depend on the geometrical size of the magnetosphere and are less sensitive to individual substorms, and types which are very

much dependent on substorm activity. The time differences between two different phenomena at one station or the same kind of phenomena at widely separated stations are discussed. Author

N71-13361# Communications Research Centre, Ottawa (Ontario).
SUBSTORM ASPECTS OF AURORAL ABSORPTION AND OTHER EFFECTS OF THE UPPER PART OF THE AURORAL PARTICLE SPECTRUM
Doris H. Jelly *In* ESRO Substorm Events Sep. 1969 p 45–62 refs (See N71-13356 03-13)
Avail: NTIS

Energetic electrons produce ionization in the 50–100 km region of the atmosphere which absorbs cosmic noise signals, as is shown by riometers. Auroral absorption averages and the average properties of individual substorms, particularly their longitudinal variations, are considered. In addition the poleward and east-west apparent motions of events are analysed and absorption in all regions is found to be intimately connected. The phenomena known as spikes and islands are also discussed as well as the location of the absorption during substorms relative to the energetic particle boundaries. Author

N71-13366# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
AN ESTIMATE OF THE CONFIGURATION OF THE SURFACE OF THE EARTH'S CORE FROM THE CONSIDERATION OF SURFACE FOCUS Pc P TRAVEL TIMES, SUPPLEMENT Final Report, 1 Jun. 1966–30 May 1970
Charles G. Bufe Sep. 1970 113 p refs
(Contract AF 49(638)-1759; ARPA Order 292-32)
(AD-712673; Rept-8071-33-F2-Suppl; AFOSR-70-2392TR-Suppl) Avail: NTIS CSCL 8/11

Travel times of PcP and P phases from nuclear and high explosive sources are interpreted in terms of variations in the radius of the earths outer core. This interpretation favors a core which is slightly larger and has less ellipticity than the Taggart-Engdahl reference model. Other interpretations in terms of lateral variation in mantle velocity are possible. Because of the geographic distribution of events and stations, only the northern hemisphere of the core is represented. A modified spherical harmonic analysis method is used to smooth the data and to estimate the shape of the core. The variation of core radius determined from this representation of data truncated at one standard deviation is approximately plus or minus 10 kilometers on the basis of terms to degree and order 5. Variations in geoid height resulting from the inferred variations in core radius do not correlate with, but are of the same order of magnitude as, those determined from satellite observations. PcP amplitude/period shows little variation with ep central distance. The PcP phase is generally shorter in apparent period than the P phase. This relationship is reversed, however, for arrivals from the Novaya Zemlya event of October 27, 1966. Ray tracing techniques are used to estimate the perturbation of the PcP-P time interval and PcP/P amplitude ratio produced by a hypothetical upper mantle low velocity zone of varying thickness. Author (TAB)

N71-13373# Oregon State Univ., Corvallis. Dept. of Oceanography.
DATA FROM THEMIS MOORED INSTRUMENTED OCEAN ARRAY 1 Data Report, Nov. 1968–Nov. 1969
Kathy Gilbert, Asa Robinson, Robert Still, and Toshitsugu Sakou Sep. 1970 39 p refs Sponsored by Navy
(Proj. Themis)
(AD-712771; DR-43; Rept-70-25) Avail: NTIS CSCL 8/3

A summary of the first year of the THEMIS observation program is presented. The observations were made from November, 1968 to November, 1969. The primary measurements were time series of current velocity with supplementary data of wind velocity. The emphasis is on the methods of observation and the procedures used in data reduction and analysis. Discussion and interpretation of the initial analy is is also presented. Author (TAB)

N71-13378# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
TURBULENCE AND GRAVITY WAVES IN THE UPPER ATMOSPHERE
C. M. Tchen Sep. 1970 100 p refs
(Contract DAHC15-67-C-0011)
(AD-713065; RP-P-595; IDA/HQ-70-11468) Avail: NTIS CSCL 4/1

The report surveys the significance of fluid dynamical motions in the terrestrial thermosphere, placing emphasis on important problems that are as yet unsolved. When the need of interpreting certain important new atmospheric phenomena arises, the author attempts to develop new theories, using, if possible, the simplest mathematical methods, or even dimensional arguments. In this connection, theories are developed on the following: the minimum scales of gravity waves, the spectrum of gravity turbulence, the spectrum of shear turbulence, and the turbulent diffusion and anomalous distribution of oxygen in the atmosphere. Author (TAB)

N71-13382# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ATMOSPHERIC DENSITY AND ROTATION BELOW 195 km FROM A HIGH-RESOLUTION DRAG ANALYSIS OF THE OV1-15 SATELLITE
Barbara K. Ching 12 Oct. 1970 20 p refs
(Contract F04701-70-C-0059)
(AD-712688; TR-0059(6260-10)-5; SAMSO-TR-70-353) Avail: NTIS CSCL 4/1

A drag analysis has been conducted using high-accuracy C-band radar data. Densities were measured at heights between 135 and 195 km at approximately 1-day intervals over a 4-month period during 1968. On the average, the results were in reasonable agreement with currently used model atmospheres, but the variability of the density was found to be much larger than predicted by the models. Density variations of the order of 10 to 20 percent at 170 km were observed to correlate with moderate geomagnetic activity and the semiannual effect. A large increase of about 35 percent at 140 km was observed during a major geomagnetic storm. The effects of solar activity, the diurnal bulge, and latitude were not apparent in the data except that the density response to geomagnetic activity was significantly larger in the northern auroral region than elsewhere. The atmospheric rotation rate at 175 km was found to be higher than that of the earth by a factor of 1.1 to 1.3. Author (TAB)

N71-13387# California Univ., Los Angeles.
OCEANOGRAPHIC INSTRUMENTATION SYSTEM FOR IN SITU MEASUREMENTS
Shmuel Ben-Yaakov (Ph.D. Thesis) 1970 343 p refs
(Contracts AT(11-1)-34; AT(04-3)-34)
(TID-25476) Avail: NTIS

An oceanographic instrumentation system has been developed and applied to in situ carbonate saturometer measurements. The system is composed of a submerged assembly and a surface data reduction unit built around a small, general-purpose digital computer (PDP-8/L). Five parameters: pH, Eh, temperature, depth and sea-water conductivity can presently be measured by the system. Salinity is calculated from conductivity measurements which are obtained by using a newly developed sensor built around a self-balancing photoconductive circuit. The results of these experiments substantiate the conclusion that the Pacific Ocean off Southern California is supersaturated with respect to calcite down to 500 meters, whereas the intermediate waters are close to equilibrium with calcite to a depth of approximately 2500 meters. Author

N71-13392# Kiruna Geophysical Observatory (Sweden).
ESTIMATION OF PARAMETERS OF INTERNAL GRAVITY WAVES FROM ELECTRON CONTENT MEASUREMENTS
Ludwik Liszka Mar. 1970 15 p refs
(KGO-703) Avail: NTIS

It is frequently found that the electron content obtained from satellite beacon observations varies in a semiregular way. These variations have been attributed to changes in the ionization density due to the passage of a gravity wave. Assuming that the disturbance is located at a fixed height, spatial wavelength, phase velocity, and the direction of the propagation have been determined. However, it has been shown that in particular in the case of the topside electron density slowly decreasing with height, the disturbance produced by a gravity wave is distributed over a wide range of heights. For this reason the simple triangulation technique cannot give satisfactory results in the common case of a broad vertical electron density profile. It has been proposed that the wave parameters of a gravity wave responsible for the observed disturbance may be estimated by comparison of observations with model calculations. An example of application of the method to six S-66 satellite orbits of March, 1965, recorded at Kiruna (67.8 deg N, 20 deg E) and Abisko (68.4 deg N, 18.9 deg E) is presented here. Author (ESRO)

N71-13393# Kiruna Geophysical Observatory (Sweden).
MODEL CALCULATIONS OF TRAVELLING IONOSPHERIC DISTURBANCES IN THE INHOMOGENEOUS IONOSPHERE
Ludwik Liszka Mar. 1970 26 p refs
(KGO-701) Avail: NTIS

Travelling ionospheric disturbances have been attributed to corresponding disturbances of the neutral gas connected with the passage of internal gravity waves. Internal gravity waves effects on the ionospheric ionization density have been extensively discussed by Hooke (1968). These major effects are as follows: (1) In the F2-region the dominant effect of the gravity waves is due to transfer of the neutral gas motion, parallel to the magnetic field lines to the ionization through collision interaction. (2) At or below F1-layer chemical effects, in particular the effect of gravity waves on the rate of photo-ionization, are important. (3) Gravity waves affect the rate of photo-ionization at a given point by changing both the neutral gas number density and the ionizing radiation flux at that point by absorption in the atmosphere above it. In the present report the theory derived by Hooke is adapted to the F2-region in presence of horizontal gradients of the ionization density and a number of model calculations are made. Author (ESRO)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N71-12557*# Scripta Technica, Inc., Washington, D.C.
THE OPERATION OF KCh-1 QUARTZ CLOCK NO. 0110 IN OPTICAL SATELLITE TRACKING STATION NO. 1055 AT UZHGOROD UNIVERSITY [O RABOTE KVARTSEVYKH CHASOV KCH-1 NO. 0110 NA STANTSII OPTICH. NABLYUDENIY ISSKUSSTV. SPUTNIKOV ZEMLI PRI UZHGORODSKOM UNIVERSITETE]
A. G. Kirichenko et al NASA Dec. 1970 4 p Transl. into ENGLISH from Byull. Opt. Nablyudenia Isskusstvennykh Sputnikov Zemli (Moscow), no. 53, Issue 1, 1969 p 34–35
(Contract NASw-2036)
(NASA-TT-F-13350) Avail: NTIS CSCL 14B

The results of an examination of the operation of the KCh-1 quartz clock are discussed. It was found that the operation of the clock is quite sensitive to the mode of operation of the thermostats. A pulse counter was constructed to control the operation of the thermostats. Author

N71-12595*# Scripta Technica, Inc., Washington, D.C.
EXPERIENCE OF TRACKING OF THE SATELLITE PAGEOS WITH THE AFU-75 CAMERA IN ULAN-BATOR [IZ OPYTA FOTOGRAFIROVANIYA ISKUSSTVENNOGO SPUTNIKA PAGEOS KAMEROY AFU-75 V ULAN-BATORE]
R. Radnaa et al NASA Dec. 1970 3 p Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 53, issue 1, 1969 p 44–45
(Contract NASw-2036)
(NASA-TT-F-13354) Avail: NTIS CSCL 14E

Photographic tracking of the Pageos satellite using the AFU-75 camera is discussed. The camera is mounted in a special tent with a folding roof while the quartz clocks, oscilloscope, and receiver are located in the equipment room of the observatory building. The camera equatorial platform is adjusted in terms of the hour angle and polar distance of the North Star. The Pageos satellite was photographed in the Ya mode with a camera lead angle of two degrees. Author

N71-12658*# Stanford Univ., Calif.
[Cs2Te STANDARD CELL DEVELOPMENT AND ELECTRONIC CHARACTERISTICS OF SILVER HALIDES] Quarterly Status Report, Period Ending 31 Oct. 1970
W. E. Spicer 31 Oct. 1970 14 p refs
(Grant NGR-05-020-066)
(NASA-CR-111614; QSR-10) Avail: NTIS CSCL 14B

Techniques for producing CsTe cells for absolute measurements of ultraviolet radiation intensity are discussed. Cs2Te is chosen as the photocathode material for its threshold near 4.0 eV and a MgF2 window is used because it is less deliquescent than LiF. The cells confirm to the same geometry and small size as previously developed LiF-Cs3Sb cells. Author

N71-12661*# Scripta Technica, Inc., Washington, D.C.
A PLATE-HOLDER FOR THE NAFA-3S/25 CAMERA [KASSETA DLYA FOTOPLASTINKI KAMERY NAFA 3S/25]
K. K. Havlicek NASA Dec. 1970 4 p Transl. into ENGLISH from Byull. Sta. Opt. Nablyudeniya Iskusstvennykh Sputnikov Zemli (USSR), no. 53, Issue 1, 1969 p 38–40
(Contract NASw-2036)
(NASA-TT-F-13352) Avail: NTIS CSCL 14E

A plate-holder is described which can be used for taking photographs with the Camera NAFA-3s/25 not only on film, but also on glass plates. Author

N71-12662# Signals Research and Development Establishment, Christchurch (England).
SCANNING ELECTRON MICROSCOPY: A REVIEW OF THE FIRST TWO YEARS' WORK USING THE CAMBRIDGE 'STEREOSCAN' MICROSCOPE
K. Head and Jean M. Plaw Mar. 1970 66 p refs
(AD-711810; SRDE-70023) Avail: NTIS CSCL 14/2

The report is a review of the work carried out in the Materials Section of the Reliability and Measurement Group, using the Cambridge Scanning Electron Microscope. The work done using the instrument covers in house applications, both within the parent Group, and for other Groups within the Establishment; work with contractors and research organisations on contract to the Ministry; and also work for outside industry on a cost shared basis. The report does not attempt to cover all the work done, but reviews in basically chronological order some of the interesting items studied; these are selected to illustrate the scope of the equipment, and show how a breakthrough in microscope technology has been achieved. Author (TAB)

N71-12675*# Scripta Technica, Inc., Washington, D.C.
SOME RESULTS OF THE EXAMINATION OF THE SATELLITE CAMERA AFU-75 AT THE UZHGOROD TRACKING STATION [REZULTATY NEKOTORYKH ISSLEDOVANIY SPUTNIKOVOY FOTOKAMERY AFU-75 UZHGORODSKOY STANTSII FOTOGRAFICHESKIKH NABLYUDENIY ISSKUSSTV. SPUTNIKOV ZEMLI]
M. V. Bratiychuk et al NASA Dec. 1970 7 p refs Transl. into ENGLISH from Byull. Sta. Opt. Nablyudenia Isskusstvennykh Sputnikov Zemli (Moscow), no. 53, Issue 1, 1969 p 29-33
(Contract NASw-2036)
(NASA-TT-F-13349) Avail: NTIS CSCL 14E

The timing accuracy was examined and found to be 0.001 sec. The velocity and rectilinearity of the motion of the compensation device for the satellite's image motion in the focal plane were also studied. Author

N71-12695*# Scripta Technica, Inc., Washington, D.C.
PHOTOGRAPHIC OBSERVATION OF SATELLITES USING THE K-24 AERIAL CAMERA WITH POLAROID FILM [FOTOGRAFICHESKIYE NABLYUDENIYA SPUTNIKOV S POMOSHCHYU AEROFOTOR YEMOCHNOY KAMERY K-24 NA PLENKE POLYROID]
Th. M. Vermeech et al NASA Dec. 1970 5 p Transl. into ENGLISH from Byul. St Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (USSR), no. 53, Issue 1, 1969 p 41-43
(Contract NASw-2036)
(NASA-TT-F-13353) Avail: NTIS CSCL 14E

A photographic technique using Polaroid-3000 and 10,000 ASA film is described. Satellites up to sixth magnitude can be photographed with this method and the results are available 10 seconds after exposure. The satellite track is interrupted by a rotating sector; the times of interruption, together with timing signals, are recorded on a dual track magnetic tape recorder. A simple method for recording time is also described. Author

N71-12721# Deutsche Forschungs- und Versuchsanstalt fuer Luft und Raumfahrt, Oberpfaffenhofen (West Germany). Inst.fuer Satellitenelektronik.
ELECTRICAL TESTS OF SATELLITES AND PROBES [ELEKTRISCHE PRUEFUNGEN AN SATELLITEN UND SONDEN]
R. Hommel and B. Kunz *In its* Space Simulation for Satellites and Space Probes, Vol. 3 1970 18 p refs In GERMAN (See N71-12719 03-11)
Avail: NTIS

Problems of electromagnetic compatibility of an electronic system are discussed as well as the functional tests using standardized compounds of telemetry systems. ESRO

N71-12728*# Bowles Fluidics Corp., Silver Spring, Md.
FLUIDIC WIND SENSOR RESEARCH LEADING TO A FLIGHT TEST MODEL Final Report
V. F. Neradka Dec. 1970 64 p refs
(Contract NAS12-2257)
(NASA-CR-111808; R-11-13-70) Avail: NTIS CSCL 14B

Three tasks leading to the delivery of a flyable fluidic low speed wind sensor are discussed. These include a flow visualization study of the flow internal and external to the sensor with regard to velocity threshold and angular resolving capability. Based on the research, a flight-worthy model of a single axis sensor was fabricated and wind tunnel tested over the velocity range $-160 < V < 160$ ft/sec. Of particular interest is the linearity of the sensor for $V < 20$ ft/sec. Wind tunnel tests in a contaminated atmosphere were conducted and the unit continued to operate after several days in severe environments. A configuration for a model which measures air speed and direction over total spherical coordinates is presented. Author

N71-12765# Boeing Co., Seattle, Wash. Military Airplane Systems Div.
IMAGE QUALITY AND DETECTION PERFORMANCE OF MILITARY PHOTO INTERPRETERS Final Report
Charles L. Elworth, Carl L. Klingberg, and Clifford R. Filleau 21 Sep. 1970 41 p refs
(Contract F44620-69-C-0128)
(AD-712705; D182-10323-1; AFOSR-70-2484TR) Avail: NTIS CSCL 14/5

Student military interpreters viewed nine vertical aerial photographs to judge their interpretability and to answer questions concerning their contents. Image quality was manipulated to produce 32 levels of degradation for each of the nine scenes. A single index called modulation transfer function area (MTFA) was used as the measure of image quality, and this measure was compared with image quality judgments and with photointerpreter performance in answering questions about image contents. Product-moment correlations between MTFA and interpreter performance averaged +.72 for the nine scenes; between MTFA and image quality judgments, they averaged +.90; between quality judgments and performance, the average was +.70. As a criterion for imaging system evaluation and specification MTFA appears worthy of further exploration. Author (TAB)

N71-12768*# Time-Zero Corp., Torrance, Calif.
PLASMA PROBE C, D, AND E, VOLUME 1 Final Engineering Report
R. A. Rivas, Dean Aalami, and Rene Evelyn-Veere [1970] 324 p ref
(Contract NAS2-3374)
(NASA-CR-73486) Avail: NTIS CSCL 14B

The Plasma Probe instrument was designed for the Pioneer C, D and E spacecraft to measure ion and electron density and angular distribution in outer space. An electrometer amplifier converts the negative and positive ion flux collected on its target to a bipolar signal proportional to the energy per unit charge as determined by the optic electro-static potential, solar wind flux, and direction. The output is dc-compressed at 2/3 of full scale input to keep the output swing to a reasonable value in measuring 5 magnitudes of signal range. The output is positive for negative particles and negative for positive ions. A Compression and Pulse Width Modulator performs a linear logarithmic compression on the piece-wise linear output of the electrometer amplifier. The output of this section is a pulse with modulated signal logarithmically proportional to the input flux. Maximum pulse width is equal to minimum flux and minimum pulse width is equal to maximum flux. Author

N71-12769*# Time-Zero Corp., Torrance, Calif.
PLASMA PROBE C, D AND E, VOLUME 2 Final Engineering Report
[1970] 358 p refs
(Contract NAS2-3374)
(NASA-CR-73487) Avail: NTIS CSCL 14B

Integrated circuits have been designed for highspeed, general purpose digital applications where high dc noise margin and relatively low power dissipation are important system considerations Definitive specifications are provided for operating characteristics over the full military temperature range of -55 C to $+125$ C. This logic series includes the basic gates, flip-flop elements and complex logic and storage elements needed to perform all functions of general-purpose digital systems. Comprehensive laboratory tests were conducted to determine noise immunity data of these units at temperatures of 0 F. to 130 F. The results are tabulated in this section along with the manufacturers specifications. Author

N71-12770# Sandia Corp., Albuquerque, N.Mex. Mechanical Design Div.
A COMPUTERIZED COORDINATE MEASURING SYSTEM

FOR PRINTED CIRCUIT MASTERS
C. L. Stoner Aug. 1970 14 p
(SC-M-70-461) Avail: NTIS

A computer-aided coordinate measuring machine with a closed circuit television viewing system is described. Beyond simple measuring abilities, this combination can semiautomatically compensate for misalignment errors, report differences between nominal and actual locations and any out-of-tolerance readings, and generate numerically controlled drilling tapes. Designed to measure various types of precision graphics, it seems especially useful for inspecting printed circuit board masters. Author

N71-12771# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
AUTOCURRENT NEUTRON DETECTORS WITH FAST RESPONSE [DETECTEURS DE NEUTRONS TYPE 'AUTO-COURANT' A RESPONSE RAPIDE]
R. Verdant 26 May 1970 52 p refs In FRENCH
(CEA-N-1330) Avail: AEC Depository Libraries

At a neutron flux of 10 to the 14th power/sq cm/S, a new type of detector having fast response times was realized. The emitter of this new type was made of a body activated with products having a time period much longer than the previous types. The current supplied by this detector whose emitter is cobalt, originates from Compon electrons produced by gamma radiation captured from the reaction Co-59(n,gamma)Co-60. Its sensitivity was of the order of (7 + or − 0.8) times 10 to the −23rd power A/nv/cm for an emitter of 1/mm diameter and response time less than a second. The three types of experimental detectors accumulated a flux of 6.10 times 10 to the 20th power n/sq cm without any change in current. The parasitic elements due to gamma-radiation of the reactor were less than 5%. NSA

N71-12772# Weather Wing (2nd), APO 332, New York.
SATELLITE PICTURE INTERPRETATION FOR EUROPE
Richard E. Williamson 30 Sep. 1970 62 p ref
(AD-712393; Rept-2WW-T N-70-3) Avail. NTIS CSCL 4/2

The publication discusses various terrain features and synoptic features of Europe, Africa, and the Middle East. It presents satellite pictures and a brief analysis of the content of the pictures. Author (TAB)

N71-12776*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HOLOGRAPHIC INSTRUMENTATION APPLICATIONS
Boris Ragent and Richard M. Brown, eds. Washington 1970 249 p refs Conf. held at Moffett Field, Calif, 13–14 Jan. 1970
(NASA-SP-248) Avail: NTIS CSCL 14E

Selected papers are presented on application of holographic instrumentation to nondestructive testing, optical memory and data processing, measurement of small linear and angular displacements, study of fluid heat transfer phenomena, and wind tunnel flow visualization. For individual titles see N71-12777 through N71-12799.

N71-12777*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REVIEW OF HOLOGRAPHIC INSTRUMENTATION AT AMES RESEARCH CENTER
Boris Ragent *In its* Holographic Instrumentation Appl. 1970 p 1–8 ref (See N71-12776 03-14)
Avail: NTIS CSCL 14E

The interest in holography has involved investigation of its applications to measurement and data-recording problems in low-density flow visualization, vibration mapping, particle sizing, contouring, and panel flutter. Efforts have been concerned with the design of a holographic system utilizing active servostabilization for vibration compensation application to a noisy wind tunnel environment. A double-exposure holographic system has also been employed. Initial test results are encouraging, but inconclusive. Contracts with other research organizations have been employed to investigate the limitations and possible extensions of the capabilities of holography to measurement problems. Author

N71-12778*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HOLOGRAPHY IN THE TEST AND EVALUATION DIVISION AT GODDARD SPACE FLIGHT CENTER
Michael W. Michalak *In its* Holographic Instrumentation Appl. 1970 p 9–12 refs (See N71-12776 03-14)
Avail: NTIS CSCL 14E

Initial research efforts have been directed toward applying holography to thermal distortion analysis. These efforts have led to studies involving real-time and double-exposure holography, effects of vacuum on recording materials, contamination possibilities, and feasibility of multiple exposures. Real-time and double-exposure capabilities have been demonstrated. Tests indicate that vacuum has little or no effect on holographic image quality and that contamination due to plate outgassing is not significant. Research is being carried out to determine optimum parameters for multiple-exposure holography. Up to ten images have been recorded on a single plate. Author

N71-12779*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REVIEW OF HOLOGRAPHIC INSTRUMENTATION AT JET PROPULSION LABORATORY
Robert V. Powell *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 13–17 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

Nondestructive testing techniques utilizing optical, acoustic, and microwave holography are investigated. Spray-particulate distribution measurements are being made to study the combustion process in liquid rocket engines. Measurement techniques are also being developed to study heat transfer in arc lamps. Author

N71-12780*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REVIEW OF HOLOGRAPHIC INSTRUMENTATION AT MARSHALL SPACE FLIGHT CENTER
John R. Williams *In its* Holographic Instrumentation Appl. 1970 p 19–31 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

Investigations into various areas of holographic technology include both basic and applied research. The areas under investigation are: (1) hypervelocity holography; (2) holographic nondestructive testing of honeycomb, epoxy joints, metal welds, etc.; (3) holographic stress analysis of solder joints and printed circuit boards; (4) lifetime predictions of materials under cyclic loads by optical correlation; (5) velocity and size distributions of particle fields; (6) holographic analysis of contaminate deposits on optical surfaces; and (7) testing of large optics by holographic interferometry. A review of both past and planned future work is presented, as well as the continuing projects. Personnel, lab space, and equipment are briefly discussed. Author

N71-12781*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REVIEW OF HOLOGRAPHIC INSTRUMENTATION AT LANGLEY RESEARCH CENTER
Joseph H. Goad *In its* Holographic Instrumentation Appl. 1970 p 33–40 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

Initial experimental results were obtained in applications involving interferometric flow visualization, dynamic particle sizing, interferometric measurement of displacements by surface contouring or vibration mapping, and nondestructive testing, and results of each application are summarized. One problem area in applying the above techniques to dynamic events is the availability of a

pulsed laser with a highly coherent output, a subnanosecond pulse duration, the ability to be synchronized or slaved to the event, and a good pulse-to-pulse reliability. Areas of interest are outlined in which holography could possibly provide more meaningful or unobtainable data. Author

N71-12782*# GC Optronics, Inc., Ann Arbor, Mich.
HOLOGRAPHIC TECHNIQUES FOR THE ANALYSIS OF STEADY-STATE AND TRANSIENT VIBRATIONS
Charles F. Jacobson and Peter A. Hubbard *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 41–55 refs (See N71-12776 03-14)
(Contract NAS8-21369)
Avail: NTIS CSCL 14E

The use of holography as a tool for the analysis of vibration and shock was investigated. Steady-state vibrations were investigated using both time-average and real-time holographic interferometry. Techniques were developed for determining the phase of the mechanical vibrations using modulated reference or reconstruction wavefronts as well as strobed illumination in a real-time holographic interferometer. For situations such as shock, flutter, and transient phenomena, where sinusoidal single-frequency analysis is not possible, techniques for the instantaneous observation of interference fringes were developed. Specifically, real-time fringes were photographed with a high-speed motion-picture camera. Author

N71-12783*# TRW Systems Group, Redondo Beach, Calif.
HOLOGRAPHIC INSTRUMENTATION STUDIES
L. O. Heflinger and R. E. Brooks *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 57–72 refs (See N71-12776 03-14)
(Contract NAS2-4992)
Avail: NTIS CSCL 14E

This program is an investigation of holographic techniques applicable to NASA's instrumentation needs. A number of interferometric and schlieren systems were devised, analyzed, and tested in the quest for a system sensitive enough to enable flow visualization at reentry simulation pressures. Some of the systems are described, such as subfringe interferometry, high-order interferometry, multipass interferometry, and double-exposure schlieren. Techniques were developed for improving the usefulness of pulsed ruby lasers for front-lighted holography and interferometry. The production of pulsed ruby holographic contour maps, achieved by two-frequency operation of the pulsed ruby laser, is briefly described. Author

N71-12784*# Radiation, Inc., Melbourne, Fla. Electro Optics Center.
INVESTIGATION OF OPTICAL MEMORY TECHNIQUES
Albert A. Friesem and Howard N. Roberts *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 73–88 refs (See N71-12776 03-14)
(Contract NAS12-2200)
Avail: NTIS CSCL 14E

An investigation into the feasibility of using holographic techniques for a read/write optical memory, having no moving parts, which is capable of storing ten billion to one trillion bits is discussed. The emphasis is to evaluate various holographic techniques and determine what storage material is most suitable. Other components of the system such as the input array, output detector, deflection and scanning systems, and light sources are also considered. The results of the investigations are to be used to determine the requirements for the storage materials and to specify the performance bounds of the system. Author

N71-12785*# TRW Systems Group, Redondo Beach, Calif.
APPLICATIONS OF HOLOGRAPHY TO APPLIED MECHANICS
Robert Aprahamian and David A. Evensen *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 89–101 refs (See N71-12776 03-14)
(Contract NAS1-8361)
Avail: NTIS CSCL 14E

Three specific areas are considered, namely, transverse vibrations of beams and plates, transient-transverse response of beams under impulsive loads, and transverse-wave propagation in beams resulting from impulsive loads. Continuous wave, time-average holographic interferometry was used extensively to determine the transverse vibrations of vibrating beams and plates at frequencies as high as 20 kHz. In addition, several selected modes as high as 100 kHz were recorded. A comparison is given of experimental and theoretical values of mode number relative to frequency and mode shapes. The transient response of a cantilevered beam was recorded using stored-beam interferometry. A high-speed motion-picture camera placed behind the hologram was used to record the resulting motion of the fringes. Analysis of the images on the motion-picture film provided the transient response, which is compared with the analytically predicted response. The results show excellent correlation. Holograms were made of transverse waves propagating in a long beam clamped on both ends. The transverse waves were introduced by striking the beam at its center with a ballistic pendulum. Three double-exposure, interferometric holograms are shown for the beam 12.5, 25, and 50 microsec after the ballistic impact. Author

N71-12786*# Arkansas Univ., Little Rock. Graduate Inst. of Technology.
INSTRUMENTAL HOLOGRAPHIC TECHNIQUES
G. S. Ballard and M. K. Testerman *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 103–115 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

A method of dual-exposure holographic interferometry is described that uses a separate reference beam for each of the two exposures. The application of this method to comparison of optical components and measurement of small phase deviations is discussed. A number of photosensitive processes, other than the silver halide gelatin emulsion, are being investigated for possible application as a medium for hologram recording and data storage. This work and the associated spatial noise considerations are summarized, and several instruments built to aid in this investigation are described. Author

N71-12787*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLYING HOLOGRAPHY TO REACTING-SPRAY STUDIES
Richard M. Clayton and Ralph F. Wuerker (TRW Systems Group, Redondo Beach, Calif.) *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 117–127 refs (See N71-12776 03-14)
Avail: NTIS CSCL 14E

Holographic techniques for studying liquid rocket combustion processes are discussed. Feasibility studies of the technique for recording reacting-spray particle-size information were implemented, including the design and construction of a two-beam, pulsed ruby laser holocamera, and its operation. The resulting holocamera was used to record confined reacting sprays occurring inside 3- and 18-in.-diameter windowed rocket chambers, as well as unconfined (atmospheric pressure) sprays. The holographic apparatus is described, and some of the pertinent results are presented. It is concluded that holograms of reacting sprays are feasible, but that the technique needs further development if information elucidating spray-combination phenomena are to be obtained. Author

N71-12788*# Electro-Physics Co., New York.
OPTICAL PROCESSING OF MICROWAVE SIGNALS FOR NONDESTRUCTIVE TESTING
Robert W. Cribbs *In* NASA. Ames Res. Center Holographic

Instrumentation Appl. 1970 p 129–145 (See N71-12776 03-14)
(Contract NAS7-759)
Avail: NTIS CSCL 20F

A research program is being conducted to analyze microwave nondestructive testing data with optical computers. The program objective is to scan large dielectric objects (for example, large solid propellant grains) with a microwave beam and produce a picture of any discontinuities within the structure. Resolution along the scanning direction is achieved by recording and processing a microwave hologram. Resolution along the microwave beam is achieved by a Fourier transform of a full waveguide band microwave sweep. This depth resolution is unlike the ordinary holographic depth preception in that this resoltuion in independent of the distance from the scanning plane to the object. Author

N71-12789*# Sperry Rand Corp., Huntsville, Ala. Space Support Div.

HOLOGRAPHIC INTERFEROMETRY AS A MEANS OF MEASURING SMALL LINEAR AND ANGULAR DISPLACEMENTS

Barton J. Howell *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 147–159 refs (See N71-12776 03-14)
Avail: NTIS CSCL 20F

Double-exposure and real-time holographic interferometry were studied experimentally and theoretically to determine the accuracy with which displacements can be measured. Results for angular motion and lateral shifts of a diffuse target block are shown. A general theory is developed that accounts for both angular and linear motion. An error model treats the accuracy of linear and angular measurements considering the two largest sources of error: (1) measurements of fringe spacing and (2) measurements of experiment geometry. Author

N71-12790*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NONDESTRUCTIVE TESTING BY HOLOGRAPHIC INTERFEROMETRY

John R. Williams *In its* Holographic Instrumentation Appl. 1970 p 161–179 ref (See N71-12776 03-14)
Avail: NTIS CSCL 20F

Both real-time- and double-exposure holographic techniques are discussed. Basically, these consist of recording, in the form of holograms, the condition of the test specimen under a known load and comparing this recorded information with that obtained when the load conditions are changed. Faults show up in the interference patterns produced. Results using these techniques on printed circuit boards, honeycomb structures, metal welds, and deposits on optical surfaces are presented. Author

N71-12791*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NONDESTRUCTIVE TESTING BY OPTICAL CROSS-CORRELATION

Rodney W. Jenkins *In its* Holographic Instrumentation Appl. 1970 p 181–188 (See N71-12776 03-14)
Avail: NTIS CSCL 20F

Since reliability is a crucial factor in space systems, it is desirable to be able to predict the lifetime of the components of that system under the performance environment. A technique using optical cross-correlation shows promise as a method of nondestructively testing and predicting the lifetime of printed circuit boards (and other materials) under an environment of thermal cycling. The technique uses a Fourier transform hologram of the printed circuit board as a matched filter. Since the amplitude of the output from the matched filter is related by a cross-correlation integral to the deformation of the printed circuit board due to thermal cycling, an estimate of the lifetime of the printed circuit board under thermal cycling can be obtained. Author

N71-12792*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ONBOARD OPTICAL PROCESSING

James P. Strong, III *In its* Holographic Instrumentation Appl. 1970 p 189–196 (See N71-12776 03-14)
Avail: NTIS CSCL 20F

Onboard optical processing is considered for extracting parameters from raw data, which can be then transmitted back to earth to provide useful information about the spacecraft data. A spacecraft optical processing system can be simulated with the image generator and the Fourier transform plane detector. Such a system permits the experiments necessary for developing an optical-digital computing system. Author

N71-12793*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FRINGE STABILIZATION FOR HOLOGRAPHY

Richard M. Brown *In its* Holographic Instrumentation Appl. 1970 p 197–203 refs (See N71-12776 03-14)
Avail: NTIS CSCL 14E

Motion of the standing interference fringe pattern during exposure of a hologram is known to degrade the brightness of the holographic reconstruction. Sinusoidal motion is more damaging than linear motion in this respect. A device that stabilizes the fringe pattern in a holographic system in the presence of component vibration and drift is described. Some design considerations are discussed and the experimental results explained. The system is shown to compensate for large path-length changes at frequencies up to several hundred Hz and to operate down to dc. This system, when applied to holography, makes it competitive in many cases with pulsed laser holography. Author

N71-12794*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FLASH HOLOGRAPHY APPLIED TO FLUID HEAT-TRANSFER PHENOMENA

Charles G. Miller and James B. Stephens *In* NASA. Ames Res. Center Holographic Instrumentation Appl. 1970 p 205–212 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

A program of studies concerning fluid heat transfer at the anode of a high power xenon compact-arc lamp is discussed. Flash holograms of the hot-gas paths around the outside surface of the anode indicate the particular anode shapes that give turbulent or laminar flow when used in developmental arc lamps. Another aspect is the nucleate boiling of the water-cooling medium in the inner surface of the anodes. Flash holograms will be made of the inside of an anode surface to study the development of nucleate boiling processes in relation to surface material and condition. Author

N71-12795*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A HOLOGRAPHIC FLOW VISUALIZATION SYSTEM

Richard M. Brown *In its* Holographic Instrumentation Appl. 1970 p 213–219 refs (See N71-12776 03-14)
Avail: NTIS CSCL 14E

There have been many attempts to apply holographic interferometry to the examination of fluid flow fields. To investigate the application of holography to airflow studies, a system is considered that can be used to make holograms in an extremely noisy wind tunnel environment. Details and features of the system are examined; for example, the advantages and disadvantages of diffusers are discussed. A variable ratio beamsplitter that makes efficient use of the laser light is described. Author

N71-12796*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INTERIM TESTS ON A HOLOGRAPHIC TECHNIQUE FOR

PHOTOGRAPHING HIGH-SPEED MIL-SIZE PARTICLES
Don M. Robinson *In its* Holographic Instrumentation Appl. 1970 p 221–235 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

A Pocket-cell Q-switched ruby laser was used to obtain single-beam, far-field holograms of 100- to 200-micron-doameter particles, which were accelerated to a velocity of approximately 2.5 km/sec. Both collimated and diverging illumination of the particles was used; however, due to the physical constraints of the test apparatus, the best results were obtained by forming the holograms at a magnification of 2. The reconstruction of the far-field holograms was accomplished with a helium-neon laser and television camera/monitor readout. This type of reconstruction enhances the signal-to-noise ratio of the process by the use of brightness and contrast control in the readout. Author

N71-12797*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTICAL DATA PROCESSING
Arnold R. Shulman *In its* Holographic Instrumentation Appl. 1970 p 237 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

The possibilities and limitations of optical data processing are considered with respect to returning large quantities of data from satellites. Emphasis is given to photographic sensors and electro-optical devices. The development of electro-optical transducers to connect electronic devices with optical computers is also discussed. R.B.

N71-12798*# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.
REVIEW OF HOLOGRAPHIC INSTRUMENTATION AT WALLOPS STATION
Frank E. Hoge *In its* Holographic Instrumentation Appl. 1970 p 239 refs (See N71-12776 03-14)
Avail: NTIS CSCL 14E

The application of holographic techniques to research in earth resources and geodetic altimetry is discussed. Techniques developed previously are to be applied in determining the surface wave energy spectra from photographs obtained from specially equipped aircraft. R.B.

N71-12799*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston Tex.
THE EFFECT OF OBJECT MOTION IN FRAUNHOFER HOLOGRAPHY WITH APPLICATION TO VELCOITY MEASUREMENTS
William P. Dotson *In its* Holographic Instrumentation Appl. 1970 p 241 (See N71-12776 03-14)
Avail: NTIS CSCL 14E

The in-line Fraunhofer hologram is analyzed on the assumption that the object moves a significant distance during the observation time. An equation is derived which predicts the effect object velocity has on the recorded fringe pattern. An analysis of the fringe pattern recorded on the film consequently yields the object velocity. It is also possible to reconstruct the resultant hologram with the result that the path the object traveled during the exposure is reproduced; this knowledge, coupled with the exposure time, yields the desired measurement of velocity. Author

N71-12986*# Scripta Technica, Inc., Washington, D.C.
INTENSITY DISTRIBUTION IN THE ECHO-2 SPECTRUM [O RASPEDELENII INTENSIVNOSTI v SPEKTRE ISKUSSTVENNOGO SPUTNIKA ZEMLI 'ZXO-2']
V. A. Smirnov et al NASA Dec. 1970 5 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov. Zemli (Moscow), no. 53, ISSUE 1, 1969 p 6–8
(Contract NASw-2036) (NASA-TT-F-13287) Avail: NTIS CSCL 14E

Curves were determined which characterize spectral features of the photographic system used for artificial satellites observations. The comparison of similar curves shows a satisfactory coincidence of the intensity distribution in the satellite spectrum and in the solar continuous spectrum. Author

N71-13120*# Alabama Univ., University. Bureau of Engineering Research.
STUDY OF TECHNIQUES FOR THE FABRICATION AND TESTING OF LARGE OPTICS Final Report
William E. Webb and Victor Schutz Oct. 1970 44 p refs
(Contract NAS8-25417)
(NASA-CR-102925; BER-124-70) Avail: NTIS CSCL 17H

The production and testing of large optics for orbital astronomical telescopes and other aerospace applications are discussed. Subjects presented are: (1) optical fabrication techniques, (2) grinding and polishing compounds, (3) environment for optical fabrication and testing, (4) optical surface measuring techniques, and (5) large mirror materials. The current status of optical equipment development and recommendations for future actions are presented. Author

N71-13124# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHADOW IMAGES OF BODIES OBTAINED AT HYPERSONIC SPEEDS BY MEANS OF A SINGLE-PULSE LASER
A. N. Berezkin et al 28 May 1970 8 p refs Transl. into ENGLISH from Zh. Nauch. Prikl. Fotogr. Kinematogr. (USSR), v. 14, no. 4, 1969 p 249–281
(AD-712803; FTD-HT-23-274-70) Avail: NTIS CSCL 14/5

A description is given of the steps involved in photographing bodies at hypersonic speeds. TAB

N71-13144# Institut Franco-Allemand de Recherches, St. Louis (France).
RADIOMETER FOR THE QUANTITATIVE EVALUATION OF SHORT-TIME ELECTROMAGNETIC RADIATION IN THE RANGE 50–500 MHz [RADIOMETER ZUR QUANTITATIVEN AUSWERTUNG KURZZEITIGER ELEKTROMAGNETISCHER STRAHLUNG IM BEREICH 50–500 MHZ]
G. Schultze and Ph. Rateau 1969 49 p In GERMAN
(T-30/69) Avail: NTIS

Highly sensitive receivers of large bandwidths and good linearity are required for studying short term electromagnetic radiation processes. Necessary broadband receivers for the region 50 to 500 MHz were developed by using relatively cheap commercial television components. Comprehensive testing with corresponding adjustments assured adequate linearity for the initial voltage potential of 10 microvolt to 1 millivolt. A number of miniaturized test transmitters with double modulation were constructed for routine surveying of receivers and linearity control as well as for standardizations. The double modulation included saw tooth shaped amplitude modulation of the impulse keyed tranamitters. Author

N71-13145# Institut Franco-Allemand de Recherches, St. Louis (France).
VISUALIZATION OF WAKES BY MEANS OF THE SCHLIEREN PROCESS THRU AMPLITUDE SUBTRACTION [VISUALISATION DES SILLAGES AU MOYEN DE LA STRIOSCOPIE PAR SOUSTRACTION D' AMPLITUDES]
H. Royer 1969 25 p refs In FRENCH
(T-38/69) Avail: NTIS

Presented and discussed are Schlieren photographs of the wake from a projectile traveling through air 2000 m/s at normal and low pressure. Example measurements on optical path gradients of the deformed wave surface are included. Author

N71-13146# Institut Franco-Allemand de Recherches, St. Louis (France).
ABSORPTION AND CONTRAST IN X-RAY FLASH PHOTOGRAPHY [ABSORPTION ET CONTRASTE EN RADIOGRAPHIE-ECLAIR]
F. Jamet and G. Thomer 1969 49 p refs In FRENCH
(Rept-9/69) Avail: NTIS

Physical aspects of imagery in X-ray flash photography are surveyed and the most important data (absorption coefficients, half value regions, etc.) for some commonly used materials are tabulated. Conditions for obtaining optimal contrasts, especially with regard to dosimetric measurements of dynamic densities, are discussed by examples. Author

N71-13154 Australian National Univ., Canberra. Dept. of Engineering Physics.
INSTRUMENTATION OF THE AUSTRALIAN NATIONAL UNIVERSITY 300 KILOGAUSS EXPERIMENTAL MAGNET
P. O. Carden and R. E. Whelan Dec. 1969 34 p refs
(EP-RR-25) Copyright. Avail: Australian Natl. Univ. Press, P.O. Box 4, Canberra, A.C.T., 2600, Australia: $A1.00

The basic features of the Australian National University magnet are described, introducing critical parameters intended to be measured. Descriptions of the design and construction of instruments to indicate mechanical stress, temperature, pressure, relative motion, current and magnetic field, are given. Author

N71-13163# RAND Corp., Santa Monica, Calif.
PSEUDOCOLOR IMAGE ENHANCEMENT BY A TWO-SEPARATION PHOTOGRAPHIC PROCESS
R. H. Stratton and Carl Gazley, Jr. Sep. 1970 7 p refs Presented at the 15th Ann. Tech. Symp. of the Soc. of Photo-Optical Instrumentation Engr., Anaheim, Calif., 14–17 Sep. 1970
(AD-712850; P-4463) Avail: NTIS CSCL 14/5

A continuous-tone black-and-white image contains intensity information equivalent to an infinite number of shades of grey. In viewing such a complex scene, the human eye can distinguish only about 15 or 20 grey levels. Since the eye can distinguish many more colors under such circumstances, a transformation of the grey scale into a chromatic scale, in which each intensity level of the original is presented as a different color, offers the possibility of transmitting more of the image information to an observer. The authors discuss the usefulness of such transformations of imagery in the fields of medicine, aerial reconnaissance, criminology, etc. Author (TAB)

N71-13164# Catholic Univ. of America, Washington, D.C. Stress Analysis Labs.
DEVELOPMENT AND APPLICATION OF METHODS OF EXPERIMENTAL MECHANICS. INTERPRETATION OF FRINGES IN STRESS-HOLO-INTERFEROMETRY Technical Report, Jan.–Jul. 1970
R. J. Sanford and A. J. Durelli Jul. 1970 53 p refs
(Contract Nonr-2249(06))
(AD-712869; Rept-24) Avail: NTIS CSCL 20/11

Previous studies had concluded that stress-holo-interferometry patterns consist of the independent superposition of the isopachic family (with half order fringe shifts) and the isochromatic family. It is shown here that this interpretation is not always valid and can result in serious errors in some cases. In particular, it is demonstrated that the position and even the existence of the fringes are affected by the interaction of the isopachics and isochromatics. This effect is most pronounced when the two families of fringes are nearly parallel and of approximately the same spatial frequency. The independent superposition interpretation is most accurate when the two families of fringes are orthogonal, whatever the ratio of spatial frequencies might be. These properties are illustrated using computer generated holographic interference patterns. In an appendix the general theory of stress-holo-interferometry is presented using matrix vector methods. The result of this analysis is a general expression for the observed light intensity of a stress-holographic-interference pattern for any arrangement of the polarization optical elements. The analysis also explains the origin of each of the terms in the light intensity expression. Author (TAB)

N71-13183# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VACUUM MEASUREMENT: MEASUREMENT OF LOW ABSOLUTE PRESSURES
M. A. Gulyaev et al 18 Aug. 1970 166 p refs Transl. into ENGLISH of the Book "Izmerenie Vakuuma Izmerenie Malykh Absolyutnykh Davlenii", 1968 p 1–147
(AD-713031; FTD-HC-23-246-69) Avail: NTIS CSCL 14/2

The book considers methods of measuring absolute pressures from a given range to very small ones that could be measured today. It describes the design, operational principles, and measurement errors. The book is intended to appeal to a wide circle of engineers and technicians dealing with methods and facilities used in vacuum technology, in the technological processes of various industrial fields, as well as in scientific research. Author (TAB)

N71-13215# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
AVERAGE RADIUS INTEGRATOR
T. W. Davidson 7 Aug. 1970 14 p
(Contract W-7405-eng-26)
(Y-1730) Avail: NTIS

An electronic instrument was designed that is capable of automatically computing the integrated average radius deviation during a latitude scan and subsequently indicating the value on a strip-chart record. The compact and inexpensive integrator system was developed for certification of parts which have surfaces of revolution and require the measurement of the average radius at one or more latitudes. Author

N71-13216# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH VOLTAGE ELECTRON MICROSCOPY AT BERKELEY
G. Thomas May 1970 4 p refs Presented at the 28th Meeting on Electron Microscopy Soc. of Am., Houston, Tex.
(Contract W-7405-eng-48)
(UCRL-19628; CONF-701003-4) Avail: NTIS

A Hitachi 650kV electron microscope was installed at Berkeley in May 1969. The research program is centered around three principal advantages which open up new areas of microscopic analyses. These advantages are: (1) the gain in transmission power with increasing voltage enabling thick specimens to be examined, (2) increased stability of organic solids to radiation damage, and (3) the disappearance voltage effect and fundamental advantages arising from many beam contrast phenomena at high energies. The increase in transmission enables materials to be examined for which preparation of thin foils is difficult. It also enables specimens to be examined in some cases without any preparation. In the study of fossils, it is particularly important to minimize preparation methods since material which has been imbedded in rocks for millions of years are usually brittle and difficult to section. An example of the fibrous structure of part of a graptolite specimen and a study of damage in as-received lunar surface particles are shown. Author

N71-13217# Cornell Univ., Ithaca, N.Y. Materials Science Center.
DIELECTRIC CRYOGENIC THERMOMETER FOR USE IN HIGH-MAGNETIC FIELDS
R. A. Brand, S. A. Letzring, and W. W. Webb 1 Jun. 1970 14 p refs
(NYO-2471-46; NYO-3029-40; Rept-1372) Avail: NTIS

The temperature dependence of the dielectric constant of KCl single crystals doped with Li was shown to provide a useful measure of temperature over the range 1 K to 30 K that is

independent of magnetic field influence up to at least 100 kOe. The field dependence, measured by calibrating the thermometer at zero, then at high field, was found to be immeasurably small and certainly less than the absolute temperature certainty (about 0.2%) at 4.2 K. The capacitance C varies with temperature T approximately as $C = A + B/T$ where A and B are positive constants with $d\ln T/d\ln C$ approximately -3 at 4.2 K. Author

N71-13218# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
FAR INFRARED INVESTIGATIONS Final Report, 1 Nov. 1967 – 31 Jul. 1970
John Strong Aug. 1970 27 p refs
(Grant AF-AFOSR-1440-68)
(AD-712742; Rept-256; AROSR-70-2255TR) Avail: NTIS CSCL 20/6

The development of a Fourier spectrometer employing a spherical lamellar grating, and the results of investigations of spectra and submillimeter wave harmonics of klystrons, obtained with the new instrument, are described. A novel optical system for matching an f/33 long absorption cell with an f/4 spectrometer and results of emission and absorption measurements of air in the long cell, and the absorption of 92 meter-atmospheres of pure CO2, are described in an appended reprint. A Bibliography of publications resulting from Air Force-sponsored research, from 1956 to 1970, is included. Author (TAB)

N71-13272# European Space Research and Technology Center, Noordwijk (Netherlands).
APPLICATIONS OF THE AGA THERMOVISION INFRARED CAMERA IN SPACE TECHNOLOGY
B. G. M. Aalders Sep. 1969 37 p refs
(ESRO-TM-150-ESTEC) Avail: NTIS

The working principles and space technology applications of the AGA thermovision infrared camera are fully described. Heat transfer studies, experiments on satellites, satellite testing, and the measurement of vestibulo-ocular reactions are discussed. Author (ESRO)

N71-13283# Duke Univ., Durham, N.C. Adaptive Signal Detection Lab.
OPTIMUM TRACKING DETECTORS
Charles P. Hatsell (Ph.D. Thesis) Mar. 1970 186 p refs
(Contract N00014-70-A-0251-0001)
(AD-712126; TR-5) Avail: NTIS CSCL 17/1

The purpose of the report is to further the theory of signal detectability for signals with time-varying parameters. Time-varying parameters are modelled by Markov statistics, and the resulting optimum detectors are termed tracking detectors. Tracking-detector design is approached with a two stage philosophy. A first stage contains the bulk of the processing and can be designed without specifying a priori knowledge regarding the unknown parameters; the a priori knowledge is accounted for in the relatively simple second stage. Tracking-detector theory is applied to the parametric signal characteristics of amplitude, phase, and waveshape. By modelling a burst-like signal as a two state Markov process, it is found that the detectability of such signals is a function of the decision threshold setting. Detectability of periodic and transient signals in noise with time-varying power is investigated and it is found that, for at least one noise model, the basic non-linearity of the optimum detector is a limiter. TAB

N71-13294# Ernst Leitz G.m.b.H., Optischewerke, Wetzlar (West Germany). Grundlagenlab.
DEVELOPMENT OF INFRARED SLOT AND HORIZON SENSORS [WEITERENTWICKLUNG VON INFRAROT-SPALT- UND HORIZONTSENSOREN]
N. Kluge, S. Rink, and H. Bauser Bad Godesberg Bundesmin. fuer Bildung und Wiss. Jul. 1970 60 p refs In GERMAN; ENGLISH summary Sponsored jointly by Ges. fuer Weltraumforsch. and Bundesmin. fuer Bildung und Wiss. Supplement to BMBW-FB-W-69-44
(BMBW-FB-W-70-40; BMBW-FB-W-69-44) Avail: NTIS ZLDI Munich: 12,20 DM

The development work on the infrared horizon sensor permitted an improvement of the old concept. By using a mirror-field optical system, only one thermocouple is necessary to get the image of the horizon edges, so that the difficulties due to different aging periods of the two thermocouples used in the former design are eliminated. For this new system a noise calculation has been established. Furthermore, the sensor weight was minimized for measuring two coordinates, two individual systems being integrated into one housing. Author (ESRO)

N71-13295# Royal Radar Establishment, Malvern (England).
MICRO-STEP COMPARATOR
G. C. Joyce and G. C. Wilson Feb. 1970 21 p refs
(RRE-TN-751) Copyright. Avail: NTIS

A comparator which can be used to measure steps of movement within the range 0.5 to 500 micrometers is described. A meter indicates the size of step and the sensitivity of the unit can be switched so that full scale deflections of the meter correspond to 10, 100, and 500 micrometers. An electrical output is provided for use with external indicating and recording equipment. The measuring element is a piezo-electric ceramic strip mounted as a cantilever. A simple device can be used to reset the output to a chosen value at any time. Author (ESRO)

N71-13296# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
[RADIO TELESCOPE AND INTERFEROMETER DESIGN] Final Technical Report, 1 Aug. 1966 – 15 Aug. 1970
Gordon J. Stanley 19 Oct. 1970 43 p refs
(Contract N00014-67-A-0094-0008)
(AD-712825) Avail: NTIS CSCL 3/2

The report is a brief history of the radio telescope and interferometer design changes which evolved over the course of a decade and a half at the Owens Valley Radio Observatory. Included also are some design calculations and a listing of past publications. TAB

N71-13299*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
COMMERCIAL INSTRUMENTATION FOR SPACE STATION APPLICATION. VOLUME 1: FEASIBILITY OF USING COMMERCIAL LABORATORY INSTRUMENTS Final Report
Allen C. Norton 31 Oct. 1970 118 p refs
(Contract NAS8-26119)
(NASA-CR-102940; FR-1065-101-Vol-1) Avail: NTIS CSCL 14B

Commercial laboratory instruments were surveyed for possible application in space station laboratories. A flyability index was developed, and all categories and subcategories of instruments were rated on dimensions relating to safety, application, logistics, performance, and operation. The handling of liquid and particulate samples was identified as a major problem for zero-gravity operation. Several sample-handling devices and techniques were discussed. It was concluded that it is feasible and desirable to use commercial instruments. Modifications are needed on most instruments to circumvent gravity-dependent functions and to improve safety. To allow review of newly developed instruments, selection of specific instruments should not be made until a late stage of flight preparation. The possibility of making last minute instrument changes is one of the advantages of using commercial instruments. Author

N71-13300*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
COMMERCIAL INSTRUMENTATION FOR SPACE STATION APPLICATION. VOLUME 2: SURVEY OF COMMERCIAL LABORATORY INSTRUMENTS Final Report
Allen C. Norton 31 Oct. 1970 319 p
(Contract NAS8-26119)
(NASA-CR-102941; FR-1065-101-Vol-2) Avail: NTIS CSCL 14B

The results of an intensive survey of commercial instrumentation applicable to space stations are presented. Details are given on twenty-four instrument categories with respect to principles of operation, applications, logistics, operation, interface, safety, modifications needed, and available instruments. Instruments under development and trends in instrument development are noted. The problems of sample handling in a zero-g laboratory and a few sample-handling devices are discussed. Author

N71-13322*# General Electric Co., Schenectady, N.Y. Specialty Fluidics Operation.
DESIGN, DEVELOPMENT, FABRICATION AND DELIVERY OF FLUIDIC ACCELEROMETERS Final Report
C. G. Ringwall 23 May 1969 39 p
(Contract NAS8-20729)
(NASA-CR-102931; S-69-1089) Avail: NTIS CSCL 14B

The objective of the current program was to develop a method of producing a pressure signal proportional to angular rate. Several alternative approaches investigated the feasibility of integrating the output of an accelerometer developed in earlier phases of the program. The accelerometer approach was also compared to a direct measurement of angular rate utilizing a gyro. On the basis of this comparison of two axis fluidic rate gyro was selected as the method to be further developed. Analytical studies were performed to determine the optimum loop configuration, design layout and other parameters for the selected method. A breadboard test model of the gyro was constructed to demonstrate basic feasibility. Author

N71-13347# Central Lab. for Radiological Protection, Warsaw (Poland).
PORTABLE TRANSISTORIZED TRITIUM CONTAMINATION MONITOR [PRZENOSNY MIERNIK SKAZEN POWIERZCHNI TRYTEM]
W. Katkiewicz and A. Jachymek 1969 9 p refs In POLISH; ENGLISH summary
(CLOR-79/D) Avail: AEC Depository Libraries

A fully transistorized portable tritium contamination monitor using an open ionization chamber was developed. The monitor was applied for surface contamination measurements from the level of 40 pCi/sq cm. The monitor has a temperature drift of 0.5 div/C, a short term drift lower than 0.5%/min, and a current drain of 1 mA. Author (NSA)

N71-13352# National Lead Co. of Ohio, Cincinnati. Technical Div.
EVALUATION OF AN EDDY-CURRENT TESTER FOR DETECTING SEAMS IN ROLLED URANIUM RODS
C. A. Neu Jun. 1970 22 p refs
(Contract AT(30-1)-1156)
(NCLO-1059) Avail: NTIS

A Roto-Bar-Tester was evaluated and found capable of detecting and measuring seams in rolled uranium rods. The instrument contains probes which rotate about the rod while the rod is moved longitudinally through the machine. Author (NSA)

N71-13355# School of Aerospace Medicine, Brooks AFB, Tex.
A RADIOFREQUENCY RADIATION EXPOSURE APPARATUS Final Report, May 1969 – Feb. 1970
John C. Mitchell Jul. 1970 15 p refs
(AD-712663; SAM-TR-70-43) Avail: NTIS CSCL 13/13

A radiofrequency radiation exposure apparatus was developed and placed into operation at the USAF School of Aerospace Medicine. The rectangular coaxial device has dimensions of 4 3/4 ft. by 9 1/4 ft. by 30 ft., with a 6-ft.-wide center conductor. It is powered by a 50-kwp. transmitter and operates in a pulsed mode at frequencies of 10.5, 19.27, and 26.6 MHz. Up to 12 animals (Macaca mulatta) can be exposed simultaneously to uniform fields ranging in power density from 0.05 to 0.2 w./sq cm. The instrumentation system, consisting of portable E- and H-field probes and fixed E-field probes, was developed and calibrated by the National Bureau of Standards. Details of the system design, checkout, and operation are presented. Author (TAB)

N71-13362# National Physical Lab., Teddington (England). Metrology Centre.
A NEW DEVELOPMENT IN THE ACCURATE MEASUREMENTS OF LOW GAS PRESSURES
R. S. Dadson Aug. 1970 8 p ref
(NPL-MC-6) Copyright. Avail: NTIS

A brief description is given of air-operated pressure balances by which the lower pressure limit may be reduced by several orders of magnitude, enabling their use as primary standards, with well defined limits of uncertainty to be extended to much lower pressures. Author (ESRO)

N71-13363# National Physical Lab., Teddington (England). Div. of Electrical Science.
AN INSTRUMENT FOR THE AUTOMATIC MEASUREMENT OF LOCAL POWER LOSS IN ELECTRICAL SHEET STEEL
A. E. Drake Jul. 1970 14 p refs
(NPL-MEMO-5) Copyright. Avail: NTIS

This report gives constructional details of a local power loss tester for several square centimeters of material together with a power amplifier with which to energize it and a thermal wattmeter system for the power loss measurement. A digital voltmeter and printer were used to automatically print out the results. Author (ESRO)

N71-13365# Texas Univ., Austin. Electronics Research Center.
A FAR-INFRARED MONOCHROMATOR
Hector J. Ruiz-Cardenas and S. S. Sesnic 3 Jul. 1970 78 p refs
Grant AF-AFOSR-1792-69)
(AD-712675; TM-20; AFOSR-70-1861TR) Avail: NTIS CSCL 20/6

The report describes the rationale for the design and construction of a far infrared grating spectrometer of plasma emission investigations as well as studies of the emission and absorption spectra and characteristics of several materials. The spectrometer will cover the wavelength region between 50 micrometers and 2000 micrometers. Scalar diffraction theory is reviewed, and a discussion of the problems of optical aberrations, doubly diffracted radiation, and Wood anomalies is presented. Ray transfer matrices and phase space concepts are introduced as design tools. Author (TAB)

N71-13379# California Univ., Berkeley. Dept. of Material Science and Engineering.
ROTATIONAL SEISMOMETER Final Report, 15 Jun. 1968 – 15 Jun. 1969
Peter W. Rodgers and Charles A. Dunn 15 Mar. 1970 31 p refs
(Contract F19628-68-C-0370; ARPA Order 292)
(AD-712632; AFCRL-70-0269) Avail: NTIS CSCL 8/11

Elastic wave theory predicts that the elastic waves generated by an earthquake and other seismic events include a measurable component of horizontal elastic rotation. Several rotational

seismometers have been designed to measure this rotational component. The first design consisted of a large inertial ring of mercury terminated in a coaxial set of stand pipes housing capacitive transducers to sense the displacement of the mercury in the stand pipes. The second design consisted of a continuous inertial ring of water with a thermistor transducer to detect flow within the pipe. The third design consisted of a continuous inertial ring of water with a thin paddle placed in the path of flow. Problems encountered involved spurious signals due to a flexible pipe, electronic noise and drift, temperature stabilization, and moisture penetration into the transducers. The capacitive transducer seemed to be the most promising, and experimentation is continuing using this transducer within a rigid steel pipe. Author (TAB)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N71-12419*# Whittaker Corp., West Concord, Mass. Nuclear Metals Div.
COEXTRUDED TANTALUM-316 STAINLESS STEEL BIMETALLIC JOINTS AND TUBING
Gerald I. Friedman [1970] 61 p refs
(Contract NAS3-11847)
(NASA-CR-72761; NM-9904.10) Avail: NTIS CSCL 13H

Techniques were established for the coextrusion of tandem and sleeve tantalum-stainless steel bimetallic joints. Large sleeve joints, 1.76 inches inside diameter with an unalloyed tantalum inner wall thickness of 0.10 inch and an AISI 316 stainless steel outer wall thickness of 0.22 inch, were produced. Extrusion procedures were also developed for the production of small sleeve joints but with an inside diameter of 0.76 inch. Conditions were established for the extrusion of tandem tantalum-stainless steel joints but with an inside diameter of 0.76 inch. Conditions were established for the extrusion of tandem tantalum-stainless steel joints of 1.76 inches inside diameter and 0.12 inch wall thickness. An attempt was made to produce 25-foot long, 0.652-inch ID bimetallic tubing having a 0.020-inch tantalum thickness and a 0.060-inch stainless steel thickness. The extrusion conditions for the production sleeve-type joints were an 8:1 reduction ratio at 1950 F, while the production tandem joints were made at a 5:1 reduction ratio at 1825 F. All joints, both those produced in the developmental phase (with one exception) and those made for production, were sound with no evidence of non-bond or any metallurgical defects. Author

N71-12541*# Scientific Translation Service, Santa Barbara, Calif.
STUDY OF A SUPERSONIC COMPRESSOR FOR A CENTRIFUGAL COMPRESSOR [ETUDE DU DIFFUSEUR SUPERSONIQUE D'UN COMPRESSEUR CENTRIFUGE]
A. Papon et al Washington NASA Dec. 1970 40 p refs Transl. into ENGLISH of French Report Presented at the Assoc. Franc. des Ingr. et Techniciens de l'Aeron. et de l'Space, 6th Colloq. d'Aerodynamique Appl., Toulouse, 12–14 Nov. 1969
(Contract NASw-2035)
(NASA-TT-F-13428) Avail: NTIS CSCL 13G

The possibility is studied of improving the design of a vane diffuser for a radial flow refrigerator compressor so as to make the diffuser more capable of accepting the high outputs of the compressor wheel. The design of a circular blade cascade in which recompression and flow can take place progressively and with a minimum of losses, regardless of the cascade stagger is discussed. The results of a preliminary investigation using hydraulic analogy to estimate the improvements possible in the diffuser design are presented. It is shown that the improvement of the diffuser performance depends on the reduction of the separation region, which can be achieved by greatly decreasing the angle of opening of the diffuser channels in the downstream direction, by increasing the rate of slow down in the recovery section, and by making the flow in the diffuser neck uniform. Author

N71-12633# Texas Instruments, Inc., Houston.
LSI RELIABILITY
Dave C. Mueller *In* AGARD Large Scale Integration in Microelectron. Oct. 1970 23 p refs (See N71-12626 03-10)
Avail: NTIS

The concept of LSI has introduced many new dimensions into the art of Quality and Reliability Assurance (QRA) in the following areas: (1) vendor selection, (2) user-supplier interface, (3) quality control, (4) product screening, (5) acceptance testing, (6) qualification testing, (7) reliability testing, (8) incoming quality inspections, and (9) failure mechanisms and analysis. Within each of these broad areas, traditional practices and concepts are being reexamined in light of procurement, economic, and system requirements considerations. Findings and current practices with regard to LSI reliability are discussed. Author

N71-12657*# Scientific Translation Service, Santa Barbara, Calif.
SURVEY OF ACCIDENTS AT THE AIR SEPARATION PLANTS
Washington NASA Dec. 1970 125 p refs Transl. into ENGLISH of J. of Ammonium Sulphate Eng. (Japan), v. 17, no. 3, 1964 p 1–47
(Contract NASw-2035)
(NASA-TT-F-13388) Avail: NTIS CSCL 13L

A large number of accidents which occurred in air separation plants in Japan and elsewhere are analyzed. Claude-type, Linde-type, and Frankel-type separation plants are discussed. Accidents were classified into explosions, bursting accidents and accidents in which humans were injured or killed. Various accident modes are analyzed, and the success of appropriate countermeasures is described. Data on all air separation plants in Japan are given. Author

N71-12819*# Franklin Inst., Philadelphia, Pa. Research Labs.
GREASE LUBRICATED SPIRAL GROOVE GYRO BEARINGS Final Report
J. T. McCabe and T. Y. Chu Oct. 1969 150 p refs
(Contract NAS8-20741)
(NASA-CR-102926; F-C2028-1) Avail: NTIS CSCL 13I

A grooved shaft rotating in a close-fitting sleeve, which can develop high pressure when designed as a viscous pump, is analyzed and tested to determine if grease lubricated spiral groove bearings are suitable for the spin axis of a gyro used for an auto pilot, or a platform stabilizing momentum wheel. A general analysis is developed and correlated, analytical and test data are presented, and properties of a class of lubricants suitable for high speed gyro spin axis bearings are tabulated. Author

N71-12926# Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Plants Div.
HEAT TREATMENT OF STEEL COMPONENTS IN WATER-AIR DISPERSION
S. Kotrc 1970 9 p refs
(ZJE-77) Avail: AEC Depository Libraries

A description of heat treatment of large steel components of a pressure vessel by accelerated cooling with a water–air mixture is given and compared with the cooling by the classical cooling media (water, air, oil). Special emphasis is given to methods for the acceleration of cooling and to the cooling efficiency of water–air mixture. Author (NSA)

N71-13147# Technische Hochschule Munchen (West Germany).
THE TRANSFER BEHAVIOR OF PNEUMATIC TRANSMISSION LINES [DAS

UEBERTRAGUNGSVERHALTEN PNEUMATISCHER LEITUNGEN]
Otto Kuenzel (Ph.D. Thesis) 1970 26 p refs In GERMAN
Avail: NTIS

Dynamic characteristics of pneumatic transmission lines are evaluated by: (1) calculating transmission parameters and their thermodynamic dependences on small signal amplitudes as well as by experimental determination of dependences at large signal amplitudes; and (2) application of electrical flow theory and obtained transmission values (calculation with distributed parameters), respectively, approximative solutions (calculation with concentrated parameters). Transl. by G.G.

N71-13148# Technische Hochschule Munchen (West Germany).
THEORETICAL AND PRACTICAL INVESTIGATIONS ON SELF-PUMPING HYDROPNEUMATIC SUSPENSION ELEMENTS FOR MOTOR VEHICLES [THEORETISCHE UND PRAKTISCHE UNTERSUCHUNGEN AN SELBSTPUMPENDEN HYDROPNEUMATISCHEN FEDERELEMENTEN FUER KRAFTFAHRZEUGE]
Theo Meller (Ph.D. Thesis) 1970 150 p refs In GERMAN
Avail: NTIS

Self-pumping hydropneumatic suspension systems with servocontrol of the surface level by one- or two-chamber systems are investigated for their oscillating behavior in automobiles. Calculations for the two chamber system develop the corresponding dependences of a one chamber system, the properties of the suspension member, as well as the overall effectiveness of the compensation member. Changes in suspension stiffness and selfoscillation data of increasing loads on reference points show that the one chamber system is not suitable for high load differences because self oscillation values increase with increasing loads markedly. Variability of effective surfaces and gas volume distribution in the two chamber system makes it superior and able to carry fully loaded automobiles at low and almost load-independent self oscillation values. Transl. by G.G.

N71-13149*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION TORQUE OF BALL BEARINGS WITH BURNISHED MoS2 FILMS AT .1 NANOTORR AT SEVERAL LOADS USING FIVE RETAINER MATERIALS
David E. Brewe, Herbert W. Scibbe, and William J. Anderson
Washington Dec. 1970 20 p refs
(NASA-TN-D-7023; E-5840) Avail: NTIS CSCL 13I

Bearing torque was determined for burnished molybdenum disulfide 20-mm-bore ball bearings operating at a shaft speed of 3600 rpm and thrust loads from 35 to 100 lbf (156 to 445 N). Among the retainer substrate materials of cast bronze, porous bronze, AISI 440 C stainless steel, AMS 4892 nickel base alloy, and copper, bearings using cast bronze retainers were consistently lower in bearing torque. Use of copper retainers resulted in erratic bearing torque. The magnitude of bearing torque was comparable to that of conventional oil-lubricated bearings. Torque increased linearly with increasing thrust load. Continued running of the bearing as long as 20 hours resulted in slightly higher values of bearing torque. Author

N71-13165*# Mechanical Technology, Inc., Latham, N.Y.
STUDY OF HYDRODYNAMIC GYRO SQUEEZE-FILM BEARING Final Report
T. Chiang and R. L. Smith Nov. 1969 68 p refs
(Contract NAS8-21169)
(NASA-CR-102381; MTI-69TR38) Avail: NTIS CSCL 20D

The feasibility of employing squeeze film lubrication during starts and/or stops of gyroscope wheels is discussed. The behavior of hydrodynamic spiral grooved spin-axis bearings is investigated. Subjects presented are: (1) squeeze film transducer design, (2) hydrodynamic bearing design and calculations, and start up and coast down data of the gyroscope rotor with and without squeeze film action. Author

N71-13188# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FRICTION AND LUBRICATION IN METAL WORKING BY PRESSURE
A. K. Chertavskikh et al 17 Jul. 1970 496 p refs Transl. into ENGLISH of the Book "Trenie i Tekhnologicheskaya Smazka Pri Obrabotke Metallov Davleniem" Moscow, Metallurgiya, 1968 p 1-362
(AD-713033; FTD-MT-24-68-70) Avail: NTIS CSCL 13/8

The book contains a presentation of theoretical principles of the boundary friction process and a detailed analysis of problems of friction and lubrication in processes of metal working by pressure. TAB

N71-13219# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.
CLASSES OF DISTRIBUTIONS APPLICABLE IN REPLACEMENT, WITH RENEWAL THEORY IMPLICATIONS
Albert W. Marshall and Frank Proschan Aug. 1970 35 p refs
(AD-712405; D1-82-0992; Rept-26) Avail: NTIS CSCL 15/5

Age and block replacement policies are commonly used to diminish in-service failures. Unfortunately, for some items (say, those with decreasing failure rate), use of these policies may actually increase the number of in-service failures. In this paper the largest classes of life distributions are determined for which age and block replacement diminishes, either stochastically or in expected value, the number of failures in service. Bounds are obtained on survival probability, moment inequalities, and renewal quantity inequalities for distributions in these classes. It is shown that under certain reliability operations on components in a class of life distributions (such as formation of systems, addition of life lengths, and mixtures of distributions), life distributions are obtained which remain within the class. Author (TAB)

N71-13220# General Electric Co., Syracuse, N. Y. Electronics Lab.
MECHANICAL FAILURE DETECTION, PHASE 1 Final Report, Jul. 1968 - Jun. 1969
L. B. Haskin and F. H. Schlereth Mar. 1970 83 p
(Contract N00014-68-C-0452)
(AD-712128, Rept-876-GH-787) Avail: NTIS CSCL 13/9

The main objective of this program was to develop a means for the detection and prediction of a particular class of mechanical failure through the use of indirect measurements. The failure mechanism of interest in this program is gear wear. This was selected because it limits the problem to manageable proportions, is a reasonably important source of failure in mechanical systems, and because the effect of gear wear on indirect measurement is analytically describable. The design of a detector for mechanical failures is divided into two phases; signal generation and signal detection. In the signal generation phase an attempt is made to establish a correlation between an indirect measurement of a phisical condition of interest, and the occurrence of the particular condition. In the signal detection phase, an attempt is made to design a detector which automatically detects the presence of the desired signal. Author (TAB)

N71-13229*# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
AXIAL-FLOW PUMP DESIGN DIGITAL COMPUTER PROGRAM
P. Kavanagh and M. J. Miller Sep. 1970 79 p refs
(Grant NGL-16-002-005)
(NASA-CR-111574; ISU-ERI-AMES-68300) Avail: NTIS CSCL 13K

A Fortran computer program for design of axial-flow pumps based on conventional radial equilibrium blade-element analysis is presented. Flow determination is based on axisymmetric analysis at between-blade-row stations, accounting for blade-element head losses and for streamline radial shift. A Runge-Kutta procedure

is used for numerical integration of the simple radial equilibrium equation. The program input for single or multiple blade row configurations consists of machine flow coefficient, annulus inner and outer radii at computing stations, blade row design specifications, and loss correlations. Computed results consist of blade element velocity diagram and mass-averaged flow parameters. Parametric variations for design studies can be made by supplying variable design specifications and loss correlations per blade row. An outline of the flow analysis method and a complete documentation of the program are given. Author

N71-13264# Technische Hochschule Darmstadt (West Germany). Fakultnet fuer Kultur- und Staatswissenschaften.

DISTURBANCES IN INDUSTRIAL OPERATIONS: A CLASSIFYING INVESTIGATION OF DISTURBANCES AND AN ANALYSIS OF THE BEHAVIOR OF PRODUCTION SYSTEMS UNDER THE INFLUENCE OF DISTURBANCES, USING CYBERNETIC METHODS [STOERUNGEN IM INDUSTRIEBETRIEB: EINE KLASSIFIZIERENDE UNTERSUCHUNG DER STOERUNGEN UND ANALYSE DES STOERVERHALTENS BERTRIEBLICHER SYSTEME UNTER ANWENDUNG KYBERNETISCHER BETRACHTUNGSWEISE]

Juergen Greve (Ph.D. Thesis) 1970 213 p refs In GERMAN Avail: NTIS

The influence of various distrubing factors in industrial plants and countermeasures are discussed. The problem is seen from the point of view of cybernetics, control engineering, and communications. Disturbing influences are categorized according to their source and level of occurrence. Disturbances of the information process are analyzed and the behavior of industrial systems subjected to disturbing influences is discussed. Finally the influence of electronic data processing methods on disturbances and responses in industrial systems are described. ESRO

N71-13265# Oxford Univ. (England). Engineering Lab.

THE INFLUENCE OF FRETTING AND GEOMETRIC STRESS CONCENTRATIONS ON THE FATIGUE STRENGTH OF CLAMPED JOINTS

G. P. Wright and J. J. O'Connor [1970] 58 p refs Sponsored in part by Min. of Technol. and Sci. Res. Council

(Rept-1112/70) Avail: NTIS

Fretting damage and geometric stress concentrations affect the fatigue strength of clamped joints. The relative magnitudes of these effects were examined in a series of experiments and the results were interpreted using theoretical stress analysis. When full allowance was made for geometric stress concentrations, it was found that fretting could reduce the fatigue strength of B.S.L65 aluminum alloy by a factor of about 3. A mechanism is proposed for this phenomenon. Author (ESRO)

N71-13284# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRINCIPLES OF PRODUCING COATINGS OF TITANIUM, VANADIUM, AND THEIR ALLOYS BY ELECTROLYSIS OF MOLTEN SALTS

G. A. Kolobov et al [1970] 22 p refs Transl. into ENGLISH From Sb. Inst. Stali i Splavov (Moscow), no. 49, 1968 p 181-195 (AD-712940, FTD-HT-23-273-70) Avail: NTIS CSCL 13/8

The report confirms the theoretical possibility of metal crystallization in the form of a dense layer from molten salts, using as a cathode a metal which is identical with the deposited metal and thus avoiding the influence of alloy formation on the creation of the dense layer. It establishes the effect of equilibrium of the melt on the growth rate of the titanium layers and applies the principle of precipitation of titanium films through electrolysis of molten salts to producing vanadium films. The effect of the main electrolysis parameters on the precipitation rate of the titanium film from a chloride melt is studied and a mechanism for inhibiting the growth rate of the coatings discussed. Finally there is a discussion of the simultaneous deposition of titanium alloys with vanadium and the structure and properties of the coatings on iron. Author (TAB)

N71-13285# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

NONDESTRUCTIVE TEST FOR MEASURING THE STATE OF HEAT TREATMENT IN CLOSURE WELDS

C. V. Dodd and C. C. Lu Jul. 1970 23 p refs Supported by Edgewood Arsenal

(Contract W-7405-eng-26)

(ORNL-TM-3024) Avail: NTIS

The first-stage development on a nondestructive testing technique to measure the properties of resistance-welded closures on chemical munition containers was completed. A preliminary technique using a magnetic circuit was developed that measures the temper of the weld, the cross-sectional area of the weld, and the variation of cap height from nominal. Measurements of magnetic properties as a function of temper and area were made of samples of AISI type 1040 steel. A prototype probe to induce the magnetic circuit, link the magnetic circuit through the weld, and measure the magnetic flux through the circuit was designed and constructed. Tests performed on six sample welds demonstrated the capability for measuring the temper, area, and variations in cap height. Recommendations for improving the accuracy, speed, and reliability of the measurements are given. Author

N71-13286# British Steel Corp., London (England). Alloy and Stainless Steel Div.

NITROGEN CONTENTS OF WELD DEPOSITS AFTER THE WELDING OF HI-PROOF AND STANDARD AUSTENITIC STAINLESS STEELS

B. Hill [1970] 16 p

(PB-193290; M/AS/DM/0025/1/70/C) Avail: NTIS CSCL 13E

A range of standard and Hi-proof stainless steels was welded using both manual metal arc and metal inert gas techniques. Nitrogen determinations were then carried out at various positions within the weld. The Hi-proof welds were found to pick up considerable amounts of nitrogen from the parent plate. Nitrogen pick up in the standard grades was much less although some pick up did occur, probably by contamination from the surrounding atmosphere. The effect of nitrogen pick up on the ferrite content of the welds was examined and the results confirmed that the increase of nitrogen had resulted in a reduction of the ferrite content. Author (USGRDR)

N71-13308*# General Electric Co., Cincinnati, Ohio.

FABRICATION OF T-111 TEST LOOP SYSTEMS

W. R. Young *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 165-219 refs (See N71-13301 03-17)

(Contract NAS3-6474)

Avail: NTIS CSCL 13H

The construction of the first large T-111 alloy loop, corrosion loop I, was begun during early 1967. Previously, the performance and reliability of the individual components had been proven with Cb-1Zr alloy during the 5000-hour testing of the Cb-1Zr Rankine system corrosion test loop. As the welding of T-111 proceeded, it became evident that more stringent requirements for joint alinements were required to prevent external loads during welding. Such loads resulted in a few instances of weld cracking. In general, however, components were fabricated with no more difficulty than normally expected in the first application of an alloy to large systems. The most serious instance of weld cracking occurred in the boiler component and resulted in cross-leakage between the lithium and potassium circuits. Since removal of this defect, the corrosion loop has accumulated over 3500 hours of operation at test conditions, thus reaffirming the basic system reliability. The construction of the boiler development test loop is currently nearing

completion. The discussion herein is limited to three components, the lithium heater, boiler, and condenser, which are unique to this system. In each case, the fabrication sequence and related welding techniques are given primary emphasis. Author

N71-13314# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

ULTRASONIC AUTOMATIC TESTING METHODS OF WELDS USED AT SACLAY-S.T.A. [TECHNIQUES DE CONTROLE AUTOMATIQUE DE SOUDURES PAR ULTRASONS]

J. F. Chretien, A. C. Prot, and J. J. Huard [1970] 12 p In FRENCH Presented at the 8th Intern. Conf. on Nondestructive Testing, Hanover, 1–5 Jun. 1970

(CEA-CONF-1540; Conf-700613-1) Avail: AEC Depository Libraries

Specific automatic testing methods, giving in each case a map of the weld, were designed. Some applications of these methods are described, e.g., automatic tube-to-tube plate welding test with a special device allowing the test to be made inside the tube by means of a mirror for the ultrasonic beam, and automatic heavy plate electron-beam welding test using immersion and contact techniques. By use of quite simple devices and without really skilled operators, field testing is made possible, which give the welder a clear representation in the form of a map, which may be compared to a film for radiographic testing. Author (NSA)

N71-13315# Engineering Research Foundation, Trondheim (Norway). Metallurgical Dept.

ACTIVATION ENERGY FOR THE APPARENT DIFFUSION OF HYDROGEN IN MULTI-RUN METAL ARC WELD DEPOSITS Progress Report

O. Oedegard and G. M. Evans 1969 17 p refs Sponsored by Roy. Norweg. Council for Ind. and Sci. Res.

Avail: NTIS

The effusion rate of hydrogen from all-weld-metal specimens was studied over the temperature range from 22 to 84 C. The results exhibit an Arrhenius type dependence, the activation energies being 7.3 + or−1.5, 9.8 + or−1.5, and 9.5 + or−0.7 kcal/g-atom, for deposits from basic, rutile, and acid electrodes, respectively. Residual hydrogen content was found to be unaffected by heating at temperatures up to 84 C. Author (ESRO)

N71-13323*# Battelle Memorial Inst., Columbus, Ohio.

DETERMINATION OF BONDING PARAMETERS AND INSPECTION TECHNIQUES FOR CADMIUM-TO-STAINLESS STEEL BONDS AND ASSEMBLY OF TWO CAPSULE HOUSINGS Final Report

J. H. Peterson and P. J. Gripshover 28 Feb. 1968 33 p

(Contract NAS3-4255)

(NASA-CR-111573) Avail: NTIS CSCL 13H

The primary objective was to assemble two capsule housings containing the clad fuel pellet containment vessel assemblies fabricated on NAS 3-4255. In addition to these assembly procedures, bonding parameters and inspection techniques for cadmium-to-stainless steel bonds were developed. Author

N71-13395# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROGRESSIVE METHODS OF PROCESSING METALS, ALLOYS, AND OTHER MATERIALS. ELECTROCHEMICAL TREATMENT OF GAS TURBINE BLADES

I. B. Yudovin et al 5 Jun. 1970 25 p Transl. into ENGLISH of the Book "Progressivnyye Metody Obrabotki Metallov, Splavov i Drugikh Materialov. Elektrokhimicheskaya Obrabotka Lopatok Gasovykh Turbin" Leningrad, Znaniye, 1969 20 p

(AD-712938; FTD-HT-23-176-70) Avail: NTIS CSCL 13/8

The article discusses the electrochemical treatment of gas turbine blades which use hard-to-work, heat-resistant steels and alloys. Electrochemical processes are shown to increase the efficiency of machining turbine blades by 6 to 12 times over mechanical methods. Exact details of the electrochemical process and of the equipment used are given. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N71-12418# Georgetown Univ., Washington, D.C. Dept. of Physics.

RADIATIVE EMISSION FROM N-S POINT CONTACTS Progress Report

W. D. Gregory, L. Leopold, J. Bostock, R. F. Averill, and D. Repici Sep. 1970 24 p refs

(Contracts N00014-70-C-0318; F44620-68-C-0017; Proj. Themis)

(AD-712662) Avail: NTIS CSCL 20/5

The purpose of the contract is to study the mechanism for radiative emission from N-S point contacts previously reported by the principal investigators. During the first three months of operation the authors have succeeded in transmitting the radiation from the N-S contacts out of the cryostat vessel and into the room temperature environment using microwave techniques, begun studies of the effects of tip geometry on the observed radiation, established that a weak link model best fits the IV characteristics of the junctions under study, and obtained additional evidence for threshold behaviour using box integrator signal sampling techniques. TAB

N71-12425*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

APPLICATION OF LASER TECHNOLOGY TO GEODETIC MEASUREMENTS AND MAPPING Technical Summary Report

Janis Bebris Apr. 1968 22 p refs

(NASA-TM-X-66489; PM-46) Avail: NTIS CSCL 20E

Available background information on laser altimeter-rangefinder techniques was updated. The commercially available laser rangefinder-altimeter systems, systems presently under development, and some advanced concepts and techniques are described. Author

N71-12574*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

A WAVELENGTH-SELECTIVE, REPETITIVELY PULSED CO2 LASER

Philip L. Hanst and John A. Morreal Apr. 1968 24 p refs

(NASA-TM-X-66497; PM-48) Avail: NTIS CSCL 20E

A CO2 laser was constructed and operated with two gas absorption cells built into the cavity. The first of the cells contained a gas which controlled the wavelength of emission. The second contained a gas which forced the laser into a high-frequency pulsed mode of operation. Details of the laser construction are given. The pulsing and wavelength shifting are accounted for by the spectroscopic and kinetic properties of the gases. The proper choice of absorbing gases produced high-powered pulsed operation at various wavelengths between 9.08 and 10.6 microns at repetition rates of up to 100 kHz. Applications of the wavelength-selective, repetitively pulsed laser include studies of nonlinear optical effects and the detection of atmospheric pollutants. Author

N71-12820# California Univ., Livermore. Lawrence Radiation Lab.

STEREO LASER FRAMING CAMERA

George T. Carpluk 29 Jun. 1970 4 p Presented at the 9th Intern. Congr. on High-Speed Phot., Denver, 2-7 Aug. 1970

Submitted for publication Sponsored by AEC
(UCRL-72543; CONF-700802-2) Avail: NTIS

A two-frame laser camera system is described which provides two-time sequential-stereo photographs of material surfaces being shocked by high explosives. The photographs show the growth, and effects of crack formation and perturbations. The design criteria are listed. F.O.S.

N71-12985# Institut Franco-Allemand de Recherches, St. Louis (France).
STUDY OF SOME METHODS OF ANALYSIS OF HOLOGRAMS OF PHASE OBJECTS, PRINCIPALLY FOR THE PURPOSE OF APPLICATIONS TO HYPERSONIC AERODYNAMICS IN THE FREE-FLIGHT TUNNEL [ETUDE DE QUELQUES METHODES D'ANALYSE DES HOLOGRAMMES D'OBJETS DE PHASE, PRINCIPALEMENT DANS LE BUT D'APPLICATIONS A L'AERODYNAMIQUE HYPERSONIQUE EN TUNNEL DE TIR]
P. Smigielski 15 Dec. 1969 57 p refs In FRENCH
(ISL-T-49/69) Avail: NTIS

The reflected wave hologram of a gaseous flow is analized by polarized light differential interferometry as well as by Schlieren method with defocussed phase filter. Application of both methods to the same hologram for measuring shifts of one or more strips makes it possible to determine the optical path differences between two neighboring light beams in the object, or the mass value equivalent to the optical path gradient. Strip orientation and adjustment of the focussing error determines the sensitivity. Results from a single hologram establish the advantages of this method in aerial flight systems; a white light visible holographic interferogram is obrained by using a Wollaston-prisma in the object beam and the reference beam as analyzer. Intensity distribution evaluations of pictures obtained by Schlieren technique with phase plates of different forms indicate that pictures from two semiplanes with phase shifts can be equivalent. The advantage of plates situated outside the focal point, as used in short time photography, constitute avoidance of possible damage by the ruby laser beams. Transl. by G.G.

N71-13018*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
LASER SYSTEM OF EXTENDED RANGE Progress Report, 1 May–31 Jul. 1970
Aug. 1970 27 p
(Contract NASw-2014)
(NASA-CR-111523; PR-2) Avail: NTIS CSCL 20E

Research progress is reported on development of a prototype laser system that will range to geosynchronous satellites and beyond. The system under development is a high-radiance, neodymium-glass laser. R.B.

N71-13021# Army Electronics Command, Fort Monmouth, N. J.
ACOUSTO-OPTIC Q SWITCH DESIGN CONSIDERATIONS
Robert Mauro Sep. 1970 70 p refs
(AD-712977; ECOM-3328) Avail: NTIS CSCL 20/5

The factors affecting acousto-optic Q switch design are presented and applied to construct a Q switch for a Nd- YAG laser. Author (TAB)

N71-13245 Lockheed Missiles and Space Co., Palo Alto, Calif.
HIGH POWER SINGLE FREQUENCY ARGON ION LASER
V. P. Beliaev et al [1970] 4 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 13, no. 2, 1970 p 223–226
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The use of a quartz discharge tube for generating the single-frequency mode of gas lasers was studied. The experimental apparatus is described, and the equations for the equivalent power coefficients of reflection for three mirror reflectors are given. The spectral composition was observed by using a Fabry–Perot interferometer in combination with interference filters to extract the generation lines. It is concluded that the single-frequency power is 0.6 to 0.7 of the multifrequency power in argon lasers. F.O.S.

N71-13266# National Physical Lab., Teddington (England). Div. of Quantum Metrology.
HARMONIC FREQUENCY COINCIDENCES BETWEEN CW GAS LASER TRANSITIONS IN THE FAR INFRA-RED
D. J. E. Knight May 1970 35 p refs
(NPL-Qu-8) Copyright. Avail: NTIS

A list of 262 CW gas laser transitions and information on laser power output, where available, for wavelengths longer than 9 micrometers was compiled from the literature and is presented in order of wavelength with computed difference frequencies between adjacent lines. The list was searched for fortuitously-close coincidences between a harmonic of one laser frequency and up to the third harmonic of a higher frequency line. All cases where the beat frequency is less than 4 GHz are listed, together with calculated beat frequency and error. A list of 52 laser lines is given for lines involved in harmonic-coincidence sequences suitable for transferring frequency measurements from the submillimeter region to the 10 micrometers region. Harmonic coincidences from this list are given for five microwave beat-frequency bands up to 220 GHz. A final table summarizes those coincidence sequences which start from the six stronger submillimeter lines and end in the 10 micrometers region. Author (ESRO)

N71-13348# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPERATING CHARACTERISTICS OF A NEODYMIUM LASER IN THE CYCLIC MODE
V. P. Veiko et al 19 Jun. 1970 14 p refs Transl. into ENGLISH From Fiz. Khim. Obrab. Mater. (USSR), no. 6, 1968 p 27-32
(AD-712813; FTD-HT-23-271-70) Avail: NTIS CSCL 20/5

The periodic operating mode of a neodymium glass laser was examined. The influence on emission parameters of heating of the active element in the course of laser operation was studied. It was noted that after switching on of cyclic pumping and cooling the laser operates for a certain period of time in the transition mode. In the course of the transition stage the energy, pulse duration, and emission divergence grow noticeably, tending to reach stationary values. A study was made of a model of this phenomenon, which explains it by the conversion of the equivalent laser resonator from plane-parallel to spherical. The parameters of the equivalent spherical resonator was evaluated. Experiments were conducted with the spherical resonator they confirmed the correctness of the assumptions put forward. Author (TAB)

N71-13396# Naval Research Lab., Washington, D. C. Laser Physics Branch.
[GAS LASER RESEARCH] Final Report, Jun. 1969–Jun. 1970
Tehmau Kan Sep. 1970 4 p
(Contract PO-9-0203; ARPA Order 660)
(AD-712564) Avail: NTIS CSCL 20/5

Research on the following topics is very briefly summarized; A DF- Co DF- CO2 vibrational transfer chemical laser; A CS2- O, CO chemical laser, the efficiency of electrode confirugations for discharge excitation lasers; and the rate of deactivation of CO2 001. TAB

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N71-12558# Oak Ridge National Lab., Tenn.
INFLUENCE OF TITANIUM ON THE HIGH-TEMPERATURE DEFORMATION AND FRACTURE BEHAVIOR OF SOME NICKEL BASED ALLOYS
Charles Edward Sessions (Ph.D. Thesis—Tennessee Univ.) Jul. 1970 189 p refs
(Contract W-7405-eng-26)
(ORNL-4561) Avail: NTIS

An investigation of the influence of titanium on the deformation and fracture behavior of nickel and a nickel base alloy, Hastelloy-N (Ni-12% Mo-7% Cr-0.07%C), was conducted. The purpose was to relate the influence of titanium on the precipitate types, morphology, and distribution to the elevated temperature mechanical behavior in creep and tensile tests. Experimental results indicate that titanium influences the mechanical behavior in Hastelloy-N and in pure nickel in two significantly different ways. In the case of Hastelloy N, grain boundary shearing is reduced owing to the influence of different carbide types and distributions, and in the case of the Ni-Ti alloys, enhanced grain boundary mobility is responsible for the enhanced hot ductility when titanium is added. NSA

N71-12560# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 11: MATERIALS COMPATIBILITY
Robert G. Brengle 3 Jul. 1970 108 p refs
(Contract AT(29-2)-2338)
(AI-AEC-12966; Rept-11) Avail: NTIS

Various interfaces of T-111 (Ta-8W-2Hf) Ta-10W, TZM (Mo-0.5 Ti-0.08Zr, 0.02C), Nb-1Zr, Mo-50Re, Pt-20Rh, AXF-5Q graphite, RPG graphite, alumina, platinized alumina, and iron titanate were tested in combinations and at temperatures that would simulate a radioisotope heat source. Testing was conducted at 2000, 2250, and 2500 F for times between 10 and 1000 hours in a hard vacuum. Results showed that the refractory metals are compatible except for an apparent instability in the TZM. Hard phases were observed in the graphite to metal interfaces and in the interdiffusion areas of the refractory metals in contact with Pt-20Rh. A new emittance coating, platinized alumina, was tested and found to be compatible with T-111. A useful equation for predicting interdiffusion distances in T-111 vs. Pt-20Rh was derived. Author (NSA)

N71-12562# Columbia Univ., New York.
HIGH TEMPERATURE SATURATED PHASE DENSITIES AND THE CRITICAL DENSITY AND TEMPERATURE OF CESIUM
George F. Oster and Charles F. Bonilla [1970] 7 p refs Submitted for publication Supported in part by NIH, Dow Chem. Co., GE, Evendale, Ohio; Linde Div., Union Carbide Corp., and Brookhaven Natl. Lab.
(Contract AT(30-1)-2660)
(CU-2660-56; CU-2660-43; Conf-700901-1) Avail: NTIS

A cylindrical capsule partially filled with the substance is suspended from transverse mid-length off-center knife edges, and its rest angle measured at various temperatures, up to horizontality. The rest angle is a function of the phase densities, and can be solved simultaneously with the rest angle from another one or more capsules containing different masses of the substance, or with any other relation between the two phase densities at the same temperature. When applied to cesium, the critical temperature was obtained as 3227 F and the critical density as 0.407 g/cc. However, by an independent method, 3235 F was subsequently obtained for the critical temperature and the average, 3231 F, is recommended as the critical temperature of cesium, with 0.406 g/cc as the corresponding critical density. Author (NSA)

N71-12563# Iowa State Univ. of Science and Technology, Ames.
THERMAL STUDY OF THREE In-Tl ALLOYS IN THE NEIGHBORHOOD OF THE fct-fcc TRANSITION; HEAT CAPACITIES FROM 6 TO 300 K An Abstract of a Dissertation submitted to the Graduate Faculty in partial fulfillment of the Requirements for the Degree of Doctor of Philosophy
Robert Gerald Schwartz May 1970 75 p refs
(Contract W-7405-eng-82)
(IS-T-362) Avail: NTIS

In this temperature range, the 28.9-at. % Tl alloy transformed martensiticly from fct to fcc, while the 34.6-at. % Tl alloy remained fcc and the 18.8-at. % Tl alloy remained fct. The entropy at 298 K was found to be 61.6 + or − 1.6 eu, 61.4 + or − 2.0 eu, and 61.1 + or − 1.6 eu for the three alloys, respectively. The alloy that transformed from fct to fcc exhibited the expected deviations from normal heat-capacity behavior. While no alloy exhibited anomalous behavior below 195 K, above 195 K all alloys exhibited anomalous 5 to 8% rises in heat capacity, occurring over a 25 to 35 K range, depending on the alloy composition. This rise in heat capacity was irreversible in the 28.9 and 34.6-at. % Tl alloys, but reversible in the 18.8-at. % Tl alloy. This behavior was corroborated by the anomalous thermal expansion coefficients of fcc and fct alloys reported by previous investigators. Author (NSA)

N71-12659# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALUMINUM ALLOYS. NO. 8, 1969 COLLECTION OF ARTICLES
I. N. Fridlyander et al 4 Jun. 1970 255 p refs Transl. into ENGLISH of the publ. 'Alyuminiyevvye Splavy,' No. 8, 1969 p 1-180
(AD-712948; FTD-MT-24-47-70) Avail: NTIS CSCL 11/6

Results of recent work on the study of the structure of mechanical, physical, technological and corrosive properties of welded aluminum are given. Questions of melt, casting, heat treatment, treatment by pressure and welding are examined. Regularties of the hardening of aluminum alloys and questions of the theory of crystallization aging are shown results are given of electron-microscopic and X-ray investigations. Author (TAB)

N71-12660# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Research Div.
FIELD ION MICROSCOPY OF TANTALUM-CARBON ALLOYS
P. Rao May 1970 5 p refs Presented at the 28th meeting on Electron Microscopy Soc. of Am., Houston, Tex., 5–9 Oct. 1970
(Contract W-7405-eng-48)
(UCRL-19630; CONF-701003-2) Avail: NTIS

Transmission electron microscopy was used to prove the existence of interstitial order in the C–Ta system. The structure of this order is suggested as Ta64C. Field ion micrographs are included along with computer generated field ion images of Ta64C. NSA

N71-12663# Illinois Univ., Urbana. Dept. of Physics.
LOW TEMPERATURE ANNEALING OF ELECTRON IRRADIATED GERMANIUM
William D. Hyatt Jun. 1970 91 p refs
(Contract AT(11-1)-1198)
(COO-1198-735) Avail: NTIS

Antimony doped N-type germanium was irradiated using 1.1 MeV electrons at 5 K. The defects produced were studied by measuring the voltage-dependent capacitance of a metal-germanium junction formed at the surface of a germanium sample. These measurements were made at 10 K and directly gave the fixed charge density near the surface of the sample. The production and recovery of defects seen near the surface is the same as seen in bulk experiments. A 0.8 MeV electron beam was used to cause radiation annealing of the defects at 5 K. The fraction recovered during radiation annealing is directly proportional to the square root of (t). A model based on diffusion-limited recovery theory is used

to explain these results. This model is also used to discuss the results of previous experiments. The temperature dependence of the observed recovery at 5 K gave a defect migration energy of 0.0044 + or − 0.0008 eV. Author (NSA)

N71-12684# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

INVESTIGATION OF FAST NEUTRON RADIATION DAMAGE IN AN AUSTENITIC STAINLESS STEEL

Everett E. Bloom (Ph.D. Thesis−−Tenn. Univ., Knoxville) Aug. 1970 175 p refs

(Contract W-7405-eng-26)

(ORNL-4580) Avail: NTIS

The nature of irradiation in Type 30r stainless steel has been deduced from a study of microstructure and density of specimens irradiated by neutrons in the temperature range 370 to 800 C to fluences of 1 × 10 to the 18th power to 5 × 10 to the 22nd power neutrons/sq cm (E > 0.1 MeV). Results of the investigations are the basis for the concept that nucleation occurs by the stabilization of void nuclei by the helium produced by (n,alpha) reactions. At low fluences and thus low helium concentrations, helium collects on dislocations and the first voids appear at these defects. As the helium concentration increases, stable nuclei form in the matrix and give a more uniform void distribution. Helium stabilization of void nuclei gives a void nucleation rate which is initially low, then increases until saturation of the void concentration occurs. The decrease in void growth rate is thought to be due to the buildup of a shell around the void within which the vacancy diffusivity is lower than in the homogeneous alloy. NSA

N71-12685# General Motors Corp., Warren Mich. Materials and Structures Lab.

MEASUREMENTS OF DYNAMIC PROPERTIES OF MATERIALS. VOLUME 1: SUMMARY OF RESULTS Final Report

William Isbell, Douglas R. Christman, Stephen G. Babcock, Thomas E. Michaels, and Sidney J. Green Jul. 1970 34 p refs

(Contract DASA01-68-C-0114)

(AD-712847; MSL-70-23-Vol-1; DASA-2501-1-Vol-1) Avail: NTIS CSCL 20/12

The PREDIX materials research program is described with particular reference to obtaining experimental data on dynamic behavior of metals. These data are intended for use in theoretical modeling of material behavior and development of computer codes for predicting material response. A qualitative analysis is given of results obtained in the general areas of stress-strain-strain rate behavior, equation of state, compressive and release wave characteristics, fracture, and thermally degraded properties. Also, the use of experimental data in evaluating models and calculations is discussed. Details of the tests conducted on aluminum, titanium, copper and tantalum, as well as a review of experimental techniques, are given in subsequent volumes in this series. Author (TAB)

N71-12686# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.

STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS Technical Progress Report, 1 Sep. 1969 −15 Jun. 1970

A. A. Hendrickson and C. C. Chen 26 Jun. 1970 8 p refs

(Contract AT(11-1)-916)

(COO-916-17) Avail: NTIS

The causes of solid solution strengthening in close-packed and bcc metals were examined by measurement of crystal flow stress versus temperature, strain rate, and solute content. Crystal flow through dislocation motions was also examined. Data are included on thermally activated glide in Ag −In solid solutions and on strain aging Ag Zn solutions. NSA

N71-12697# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF FRICTION AND WEAR OF STEELS, A HARD ALLOY, AND POLYMER MATERIALS AT LOW TEMPERATURES

E. I. Vorobev et al 1 Jul. 1970 12 p refs Transl. into ENGLISH from Khim. i Neft. Mashinostr. (Moscow), no. 12, 1968 p 20−22

(AD-712947; FTD-HT-23-342-70) Avail: NTIS CSCL 11/6

The article gives the results of friction and wear tests of hardened steels ShKh15, U10, 38KhMYuA, the hard alloy VK8, and polymer materials under different loads in a liquid nitrogen medium and the results of measurements of the hardness of tested specimens at both normal and low temperatures. The testing device shown in a figure was designed particularly for this purpose. In making the tests the clip with the specimens was fastened to the lower end of the shaft and another specimen was mounted immovably on the bottom of the cryochamber. Three specimens of the different steels 3 mm in diameter were installed in the top clip and under the application of a load had their faces pressed against the lower specimen of the disk. A belt drive transfers torque from the electric motor to vertical shaft. The cryochamber is mounted on a spherical radially seating bearing and connected with the elastic element by whose deformation the friction force was determined. The TKP-1 device for measuring hardness is shown in a figure. The steel and alloy tests showed that the dependence of wear on specific pressure in a liquid nitrogen medium is nonlinear in the general case. The greatest wear resistance was demonstrated by the friction pair of 38KhMYuA against itself. Author (TAB)

N71-12698# Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center.

FRICTION AND WEAR SCREENING TESTS OF MATERIALS IN SODIUM

N. J. Hoffman, D. E. Goggin, and J. J. Droher 15 Jul. 1970 173 p refs

(Contract AT(04-3)-700)

(LMEC-70-10) Avail: NTIS

The results of a number of screening tests on the friction and wear behavior of materials in contact within a sodium environment are presented and interpreted. The report is divided into two sections: considerations for the designer, and experimental material screening and analytical studies. The bulk of the data concerns the wear coefficient and coefficient of sliding friction at 900 or 1200 F in sodium fluid. Results from studies of coefficient of static friction and self-welding characteristics are also discussed. Materials studied included metals and alloys and carbides. Author (NSA)

N71-12737# California Univ., Livermore. Lawrence Radiation Lab.

INVESTIGATION OF THE PLUTONIUM-SILVER SYSTEM

David H. Wood, Eugene M. Cramer, and Peter L. Wallace 19 Jun. 1970 16 p refs Presented at the 4th Intern. Conf. on Plutonium and Other Actinides, Santa Fe, N.Mex. Sponsored by AEC

(UCRL-72225; CONF-701001-19) Avail: NTIS

Metallographic, X-ray diffraction, and differential thermal analysis have been used in a limited investigation of the plutonium-silver phase diagram. Two compounds were observed: PuAg3.6, which melts congruently at 977 C, and PuAg2, which melts peritectically at 817 C. A region of liquid immiscibility extends from about 2 to 59 at. % silver, at which composition there is a monotectic reaction at 795 C. A eutectic between PuAg3.6 and silver was found at 801 C and 90.8 at. % silver. These results are at variance with the literature in several respects. The occurrence of liquid immiscibility is explained in accordance with the thermodynamic reasoning of Hume−Rothery and Anderson (1960). Author (NSA)

N71-12738# California Univ., Livermore. Lawrence Radiation Lab.

PHASE TRANSFORMATIONS IN THE ACTINIDES

Alfred Goldberg and Tadeusz B. Massalski 29 Jun. 1970 122 p refs Presented at 4th Intern. Conf. on Plutonium and Other Actinides, Santa Fe, N.Mex., 5–9 Oct. 1970 Sponsored by AEC
(UCRL-72557; CONF-701001-5) Avail: NTIS

Solid-state transformations that occur in metals that belong to the actinide series, in particular, plutonium and uranium, and to a lesser extent thorium, neptunium, and americium, are summarized. In Pu, both the beta to alpha and delta to gamma transitions are mainly martensitic during rapid cooling. On slow cooling the latter transition most likely occurs by a d-n-a-g process. The delta to alpha skip transition probably occurs by a martensitic transformation The remaining transitions all appear to take place by diffusional processes. The low-temperature beta to alpha transformation in U is martensitic. On slow cooling, it occurs primarily by d-n-a-g processes. The remaining transitions, beta to alpha and gamma ≒ beta, take place by d-n-a-g processes under all conditions. NSA

N71-12821# National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.

DIFFUSION OF IRON IN SOME METALS [DIFFUZIYA ZHELEZA V NEKETORYE METALLY]

V. P. Vasilev et al 1970 15 p refs Transl. into ENGLISH from Tr. Sredneaziatskogo Gos. Univ. (USSR), no. 65, 1955 p 47–53 Prepared by NBS for NSF
(TT-70-57025; DMDC-1633) Avail: NTIS CSCL 11F

The diffusion of Fe in W, Ta, Nb and Ag was studied using Fe59. Iron diffusing in W was studied between 1210 to 1513 K. Iron diffusing in Ag was studied between 573 to 998 K. Iron diffusing in Ni was studied between 673 to 1073 K. Iron diffusing in Ta was studied between 1203 to 1513 K. Author (USGRDR)

N71-12822# Centre National de la Recherche Scientifique, Paris (France).

DEVELOPMENT WORK ON STRESS-CRACKING CORROSION OF STAINLESS STEELS [MISE AU POINT AU SUJET DE LA CORROSION SOUS TENSION DES ACIERS INOXYDABLES]

J. Montuelle, M. Cunha Belo, D. Colin, and Ph. Berge (EURATOM) May 1969 22 p refs In FRENCH Sponsored in part by EURATOM
(EUR-4000; EURAEC-2064) Avail: AEC Depository Libraries

Cracking in stainless steels under mechanical stress in boiling magnesium chloride is caused by the prior formation of a thin film of passivating oxide; it was possible to establish this point mainly by means of electron microscopy and electrochemical techniques. The role of certain factors relating to the corrosive medium was demonstrated: certain specific impurities can considerably affect the length of the incubation period)i.e., the period preceding inception of cracking). By the study of high-purity alloys, of which it is known that austenite is liable to change into martenite during cooling to a greater or lesser degree, it was possible to determine that immunity to stress corrosion of stainless steels with austeno-martensitic structure could be achieved by a purely electrochemical technique. Author (NSA)

N71-12829# National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.

INFLUENCE OF MANGANESE ON THE SELF DIFFUSION OF IRON [VLIYANIE MARGANTSA NA SAMODIFFUZIYU ZHELEZA]

P. L. Gruzin 1970 15 p refs Transl. into ENGLISH from Probl. Metalloved. i Fiz. Metallov (USSR), no. 4, 1955 p 503–508 Prepared by NBS for NSF
(TT-70-57041; DMDC-2653) Avail: NTIS CSCL 11F

A study was made of the temperature-dependence of the self-diffusion of Fe59 in FeMn alloys in the gamma-phase over the temperature range of 950-1350C. Both grain-boundary and volume diffusion were studied. Author (USGRDR)

N71-12830# National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.

AFFINITY OF METALS TO SULFUR [SRODSTVO METALLOV K SERE]

E. V. Briteke et al 1970 13 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (USSR), v. 5, no. 1, 1934 p 85–90
(TT-70-57082) Avail: NTIS CSCL 07B

The authors present their conclusions for a series of investigations on the affinity of metals to sulfur. USGRDR

N71-12888# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENT OF PARTIAL DEGASSING FLUXES IN MOLYBDENUM AND TUNGSTEN AT 2000 DEG K

Robert Lesueur 1970 10 p refs In FRENCH Presented at the Symp. on Meterology and Analysis of Gas in Ultra High Vacuum, Paris
(CEA-CONF-1516; CONF-700418-1) Avail: AEC Depository Libraries

Partial degassing fluxes are measured at 2000 K for four molybdenum samples (three are vacuum melted and the last one sintered) and two tungsten samples (the first one sintered and the other deposited on Mo by WF6 pyrolysis). A double calibration is effected in order to measure the pumping rate in the sample for each gas and the partial pressures at the same point. The device described comprises an electron microscope as a cell. The degassing time and the contents of the samples in gaseous impurities (H2, CH4, N2, CO, O2, CO2) are evaluated in order to compare and choose specific materials for use in specific applications. Author (NSA)

N71-12918# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

EFFECT OF CYCLIC STRAIN AGING ON THE EMBRITTLEMENT OF A PLAIN CARBON STEEL PLATE

A. J. Brothers and D. A. Woodford Jan. 1970 36 p refs
(Contract AT(04-3)-189)
(GEAD-10140) Avail: NTIS

The results of static and cylic strain aging effects on the Charpy Impact properties of a carbon steel plate (A-212B) are described. From these results it is concluded that: (1) Cylic strain ranges of 0.5 to 3% for up to 200 cycles in the temperature range RT to 550 F increased the Charpy 50% FATT by up to 115 F. The increase in FATT was a direct function of cylic strain range, number of cycles, and temperature, with maximum embrittlement occurring around 350 F. (2) Static deformation was considerably less embrittling than cyclic deformation for equivalent total strain ranges. (3) Notch bend tests of 0.050-in. radius, 20% deep notch bend specimens with pre-cyclically strain-aged notch regions revealed no significant influence on nominal notch bend strength. Author

N71-12919# British Iron and Steel Research Association, London (England). Metallurgy Div.

THE DETERMINATION OF TRACE AMOUNTS OF TANTALUM IN STEELS

1970 15 p refs
(PB-193294; MG/D/431/70) Avail: NTIS CSCL 11F

Precipitation with phenyl arsonic acid using niobium and zirconium as carriers forms the basis of a satisfactory procedure for the determination of the tantalum content of mild and stainless steels. Tantalum in the precipitate is isolated from interfering elements by solvent extraction and its content determined by the formation of a colored complex with pyrogallol. Collaborative trials have shown that the method is reliable provided that the operator is reasonably experienced in the analytical procedure. The method is not rapid, and a batch of six samples plus a reagent blank would require rather more than one day for completion. Trials of an alternative, more rapid method, using phenyl fluorone as colorimetric

reagent, in which preliminary precipitation is unnecessary, were less satisfactory. On acquisition of operational experience, collaborative results of a high order of agreement were obtained but the method was adjudged not to be sufficiently robust for industrial application.
Author (USGRDR)

N71-12961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ETCHING OF METALLOGRAPHIC SPECIMENS BY CAVITATION
Stanley G. Young [1970] 31 p refs Presented at the 3d Ann. Meeting of Intern. Metallographic Soc., Inc., Cleveland, 16–18 Nov. 1970
(NASA-TM-X-52929) Avail: NTIS CSCL 11F

Specimens of several unalloyed metals (zinc, nickel, iron, and tantalum) and Udimet 700 were subjected to cavitation damage in water using a vibratory apparatus. The specimens were stationary and were placed beneath an ultrasonically vibrated head. The following results were obtained: (1) preferential damage to metallurgical features in distilled water indicates that cavitation may be useful as a technique for mechanically etching materials for metallographic examination; and (2) the relative ranking of materials, in order of decreasing volume loss after approximately 400 minutes of testing was zinc, annealed nickel 270 (Ni-270), iron, as-received Ni-270, tantalum, and Udimet 700. The volume loss of zinc and Udimet 700 were displaced by three orders of magnitude.
Author

N71-12963# Kentucky Research Foundation, Lexington.
TWO CARRIER MODEL FOR A SINGLE METALLIC BAND
Progress Report, 1 Jun. 1968–31 Jul. 1970
B. R. Gossick 31 Jul. 1970 24 p refs
(Contract AT(40-1)-3651)
(ORO-3651-5) Avail: NTIS

A two carrier model is used to treat the electronic properties of a single metallic band by considering only the holes below the Fermi surface and only the electrons above that surface. The model provides some physical insight which is advantageous pedagogically for explaining the thermal and electrical properties of metals. Furthermore, the model brings into view a general expression for the Hall coefficient, and a simple relationship between that and the electronic specific heat and thermoelectric power.
Author

N71-12977# National Science Foundation, Washington, D.C.
MEASUREMENT OF COEFFICIENT OF SELF-DIFFUSION OF GOLD [IZMERENIE KOEFFITSIENTA SAMODIFFUZII ZOLOTA]
A. M. Zagruvskii 1970 23 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), no. 6, 1937 p 903–913
(TT-70-57030; DMDC-1997) Avail: NTIS CSCL 11F

Up to this time, self-diffusion of only Pb has been measured with the help of a radioactive isotope. This article describes a similar work conducted on Au by means of an artificial isotope obtained by neutron bombardment. A relation between the temperature and the coefficient of self-diffusion of gold has been obtained.
Author (USGRDR)

N71-12978# National Science Foundation, Washington, D.C.
EFFECT OF THE VALENCE OF A THIRD ELEMENT ON THE PROCESS OF DIFFUSION IN COPPER-ZINC ALLOYS [VLIYANIE VALENTNOSTI TRETEGO ELEMENTA NA PROTSESS DIFFUZII v MEDNOTSINKOVYKH SPLAVAKH]
S. Gertsriken et al 1970 21 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 20, no. 1, 1950 p 45–52
(TT-70-57081; DMDC-1565) Avail: NTIS CSCL 11F

It is shown that the valence of a third element, present in copper-zinc alloys as a contaminant, has a considerable effect on diffusion constants: activation energy and activation entropy. It is shown that a change in the activation energy and activation entropy has a linear relation with the valence of the third element. Results of the investigation have been explained assuming the functional dependence of activation energy on the bond energy in the alloy lattice. It has been shown that first of all the effect of the third element should be studied in relation to two parameters.
Author (USGRDR)

N71-12979# National Science Foundation, Washington, D.C.
PROBLEM OF IONIC DIFFUSION IN METALS [K VOPROSU OB IONNOI DIFFUZII V METALLAKH]
V. I. Prosvirn 1970 25 p refs Transl. into ENGLISH from Vestn. Mashinostr. (Moscow), v. 17, no. 12, 1937 p 102–111
(TT-70-57031; DMDC-2029) Avail: NTIS CSCL 11F

The electronic structure of metal atoms and its effect on diffusion is discussed. The diffusion of carbon and nitrogen in iron is used as an experimental example of the theoretical concepts purposed.
USGRDR

N71-12980# British Iron and Steel Research Association, London (England). Metallurgy Dept.
THE ANALYSIS OF HIGH ALLOY STEELS BY X-RAY FLUORESCENCE USING A CORRECTION FACTOR TECHNIQUE
W. Johnson 1970 77 p refs
(PB-193292; MG/D/441/70) Avail: NTIS CSCL 11F

A systematic study of the X-ray fluorescence intensity versus chemical analysis was carried out on a series of binary alloys of iron and tungsten (0-30%) molybdenum (0-12%), nickel (0-30%), cobalt (0-25%), manganese (0-15%) and chromium (0-25%). It is shown that there is a simple hyperbolic relationship between concentration and X-ray intensity which can be expressed by three constants representing the background, the intensity from the pure element and the departure from linearity of the binary system. Using these constants, a set of ternary alloys centered about the 18% Cr, 8% Ni composition was studied and the results were shown to be represented by hyperbolic interpolation between the binary end-members.
Author (USGRDR)

N71-12981# British Iron and Steel Research Association, London (England). Metallurgy Dept.
FRACTOGRAPHIC FEATURES ASSOCIATED WITH GENERAL YIELDING IN LOW STRENGTH STEELS
D. Elliott and H. Stuart 1970 8 p refs
(PB-193293; MG/C/49/70) Avail: NTIS CSCL 11F

The fractographic potential of the scanning electron microscope was exploited, enabling direct measurements to be made of features associated with the fracture surfaces of low strength structural steels. The work, using three-point bend single-edge notched test specimens of low strength steels, identified a stretched zone, the presence of which is associated with the development of plastic deformation ahead of the crack tip. The nature of this zone and its orientation with respect to the plane of the fatigue starter crack was determined. The surface is not featureless but exhibits characteristics resembling ductile flow; and the inclination with respect to the fatigue crack is approximately 45 degrees. Quantitative measurements of the stretched zone size were carried out and correlations made with the fracture toughness as measured in terms of crack opening displacement, based on the principles of general yielding fracture mechanics.
Author (USGRDR)

N71-13014# British Iron and Steel Research Association, London (England). Metallurgy Dept.
THE ANALYSIS OF ALLOY STEELS CONTAINING NICKEL, CHROMIUM, SILICON, MANGANESE, TITANIUM, NIOBIUM AND MOLYBDENUM BY X-RAY FLUORESCENCE TECHNIQUES
H. Hughes 1970 16 p
(PB-193291; MG/D/453/70) Avail: NTIS CSCL 11F

Calibration curves for niobium, titanium and molybdenum were obtained, to cover the determination of these elements in a

wide range of commercial alloys. Calibration curves for manganese and silicon were also prepared, but these require a line overlap correction in the case of manganese and an empirical correction in the case of silicon. Interelement effects were shown to occur in the cases of nickel and chronium, but a correction procedure was developed for use in the determinstion of these elements. Author (USGRDR)

N71-13031# Michigan Univ., Ann Arbor. Cavitation and Multiphase Flow Lab.
HYDROABRASIVE WEAR OF METALS UNDER CAVITATION
S. P. Kozirev May 1970 96 p refs In RUSSIAN
(Grant NSF GK-1889)
(PB-192268; UMICH-01357-10-1) Avail: NTIS CSCL 11F

Contents: Hydroabrasive wear; Equipment for testing wear of metals by abrasive cavitation; Study of cavitation phenomena and cavitation abrasive wear in hydrodynamical tunnels; Impacting specimens with water jets; Effect of water jet velocity and other factors on wear; Cavitation wear of metals; and Hydroabrasive wear on electric weld seams. USGRDR

N71-13037# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STRUCTURE AND PROPERTIES OF ALLOYS EP404 AND EP454
L. N. Zimina et al 18 Aug. 1970 12 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Inst. Chernoi Met. Sb. Trudov (USSR), no. 65, 1968 p 13–19
(AD-713048; FTD-HT-23-474-70) Avail: NTIS CSCL 11/6

The article discusses certain high-strength alloys with regard to their ability to be combined. It is noted that EP404 and EP454 can be hardened both by the decomposition of the solid solution with a given phase as well as by the separation of the Me (Mo, W) type phase. The presence of the Me (Mo, W) phase in these alloys increases their strength, but reduces their ductility and impact strength. These combined alloys are recommended for machine parts working under high loads for short periods. Author (TAB)

N71-13150# Notre Dame Univ., Ind. Dept. of Metallurgical Engineering and Materials Science.
IDENTIFICATION OF UNKNOWN PHASE OR PHASES ON A Cr-Mo-V STEEL Final Report, 15 Jun. – 1 Sep. 1970
C. W. Allen and H. Akita 28 Aug. 1970 9 p
(Contract DAHC04-70-C-0067)
(AD-712380; AROD-9565-1-A) Avail: NTIS CSCL 11/6

The reports purpose was to identify the unknown entity by high resolution electron diffraction with the corroborative information provided by X-ray diffraction performed here and elsewhere and electron probe micro-analysis performed elsewhere. Author (TAB)

N71-13152# Rensselaer Polytechnic Inst., Troy, N.Y. Materials Div.
TRANSMISSION ELECTRON MICROSCOPE STUDY OF Al-Zn-Mg
G. Judd and C. R. Shastry 9 Oct. 1970 30 p refs
(Contract N00014-67-A-0117-0009)
(AD-712809; TR-1) Avail: NTIS CSCL 11/6

The effect of quench rate on the distribution of precipitates in the matrix and at the grain boundaries with special attention to the formation of grain boundary precipitate free zones in an Al-Zn-Mg alloy aged at two different temperatures was studied by transmission electron microscopy. For relatively fast quenched specimens, definite correlation was found to exist between the width of precipitate free zones and the extent of grain boundary precipitation. The variation of precipitate free zone width with quench rate was also found to depend on the grain boundary type. For relatively slow quenched specimens, a fine matrix precipitate distribution with narrow grain boundary precipitate free zones was observed. The results are discussed in terms of the current theories of precipitation in aluminum alloys. Author (TAB)

N71-13153# Naval Research Lab., Washington, D.C.
STANDARD METHOD FOR THE 5/8 INCH DYNAMIC TEAR TEST Interim Report
Eugene A. Lange, Peter P. Puzak, and Laurence A. Cooley 27 Aug. 1970 41 p refs
(AD-712494; NRL-7159) Avail: NTIS CSCL 11/6

Fracture-safe design of structures depends critically upon the fracture toughness of the material, and remarkable advances in fracture mechanics technology have provided quantitative relationships between the mechanical aspects and the metallurgical aspects of fracture resistance. To exploit these scientific developments, the Dynamic Tear (DT) test has been under development to provide a practical, quantitative test method for fracture toughness measurement. DT energy has been used extensively for the characterization of fracture resistance of ferrous and nonferrous metals, and a direct translation to structural parameters has been developed using analysis diagrams for solving the complex analog relationship between the mechanical, metallurgical and structural aspects. A standard method for conducting the DT test using 5/8 in. thick specimens (5/8 DT) was developed to provide for uniform testing between laboratories. The standard 5/8 DT test can be used for specification purposes with 5/8 DT energy as dynamic performance criteria. Author (TAB)

N71-13282# Engineering Research Foundation, Trondheim (Norway). Dept. of Metallurgy.
CLOGGING OF THE TUNDISH NOZZLE DURING CONTINUOUS CASTING OF ALUMINUM KILLED STEEL Semiennual Report, 1968
S. Saxena and T. Grong 16 Jan. 1969 21 p refs Sponsored by Roy. Norweg. Council for Sci. and Ind. Res.
(SAR-2) Avail: NTIS

The mechanisms taking place during nozzle clogging in casting aluminum containing steel are investigated. Through laboratory experiments it has been found that there is a supersaturation in aluminum-deoxidized melts which can be decreased by the presence of a surface which provides sites for heterogeneous nucleation. The rotating refractory rod used for providing active nucleating sites shows a dendritic growth of Al_2O_3 growing from the refractory surface and surrounded by metallic iron. This aluminum oxide growth appears to be of a similar nature as the one occurring in teeming nozzle deposits. Author (ESRO)

N71-13301*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT ADVANCES IN REFRACTORY ALLOYS FOR SPACE POWER SYSTEMS Conference Papers
1970 299 p refs Conf. held in Cleveland, 26 Jun. 1969
(NASA-SP-245) Avail: NTIS CSCL 11F

CONTENTS:

1. REFRACTORY-ALLOY REQUIREMENTS FOR SPACE POWER SYSTEMS T. A. Moss, R. L. Davies, and G. J. Berns p 1–18 (See N71-13302 03-17)

2. DEVELOPMENT OF HIGH STRENGTH TANTALUM BASE ALLOYS R. W. Buckman, Jr. and R. R. Begley (Westinghouse Elec. Corp., Pittsburgh, Pa.) p 19–37 refs (See N71-13303 03-17)

3. THERMAL STABILITY OF REFRACTORY METAL ALLOYS G. G. Leesmann and R. E. Gold (Westinghouse Elec. Corp., Pittsburgh, Pa.) p 39–73 refs (See N71-13304 03-17)

4. CREEP BEHAVIOR OF REFRACTORY ALLOYS IN ULTRAHIGH VACUUM K. D. Sheffler, J. C. Sawyer, and E. A. Steigerwald (TRW Equip. Labs.) p 75–125 refs (See N71-13305 03-17)

5. EFFECT OF HEAT TREATMENT ON CREEP PROPERTIES OF THE TANTALUM BASE ALLOY ASTAR-811C D. L. Harrod and R. W. Buckman, Jr. (Westinghouse Elec. Corp., Pittsburgh, Pa.) p 127–142 (See N71-13306 03-17)

6. HIGH FREQUENCY FATIGUE PROPERTIES OF TZC AND T-111 ALLOYS E. A. Steigerwald, K. D. Sheffler, and J. C. Sawyer (TRW Equip. Labs.) p 143–164 refs (See N71-13307 03-17)

7. FABRICATION OF T-111 TEST LOOP SYSTEMS W. R. Young (GE, Cincinnati, Ohio) p 165–219 refs (See N71-13308 03-15)

8. T-111 ALLOY CRACKING PROBLEMS DURING PROCESSING AND FABRICATION R. A. Ekvall, R. G. Frank, and W. R. Young (GE, Cincinnati, Ohio) p 221–260 refs (See N71-13309 03-17)

9. WELDABILITY OF TUNGSTEN BASE ALLOYS G. G. Lessmann and R. E. Gold (Westinghouse Elec. Corp., Pittsburgh, Pa.) p 261–296 refs (See N71-13310 03-17)

N71-13302*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REFRACTORY-ALLOY REQUIREMENTS FOR SPACE POWER SYSTEMS

T. A. Moss, R. L. Davies, and G. J. Barna *In its* Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 1–18 (See N71-13301 03-17)

Avail: NTIS CSCL 11F

Various types of large nuclear space power systems are being investigated in support of missions projected for the post-1980 period. Among the approaches being considered to meet projected needs are the potassium Rankine cycle, Brayton cycle, and thermionic systems operating at relatively high temperatures in order to achieve high performance. All these systems require refractory alloys for structural purposes and employ alkali metals as process fluids. Heat for driving the systems would be supplied by a liquid-metal-cooled fast reactor. The system specific weights for the Rankine and Brayton engines are approximately the same, while that of the thermionic system would be higher. Technology programs have been conducted in support of all three types of systems and, in particular, considerable effort has been placed on characterizing the refractory alloys which would be required for the construction of the systems. Papers presented in this report are the result of these refractory-alloy technology programs. Author

N71-13303*# Westinghouse Electric Corp., Pittsburgh, Pa.

DEVELOPMENT OF HIGH STRENGTH TANTALUM BASE ALLOYS

R. W. Buckman, Jr. and R. R. Begley *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 19–37 refs (See N71-13301 03-17)

(Contracts NAS3-2542; NAS3-10939)

Avail: NTIS CSCL 11F

Described is the development of tantalum base alloys intended for application in advanced space power systems. For components such as piping in alkali metal Rankine cycle systems, radioisotope capsules, and fuel claddings in nuclear reactors, critical property criteria include excellent fabricability, good welding characteristics, long time thermal stability, and high creep strength. Tantalum base alloys which successfully meet these criteria were achieved by a balanced combination of solid solution and dispersed phase strengthening as typified by the alloy ASTAR-811C (Ta-8W-1Re-0.7Hf-0.025C). This alloy has creep strength significantly superior to T-111 (Ta-8W-2Hf) at temperatures up to 2600 F, without sacrifice of fabricability or welding characteristics. Data are presented for tensile and long time creep properties of this alloy, and the role of carbide precipitates in improving high temperature strength is discussed. Greatly improved high temperature tensile and creep properties can be achieved by an increase in tungsten level and by a substitution of nitrogen for carbon. Author

N71-13304*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

THERMAL STABILITY OF REFRACTORY METAL ALLOYS

G. G. Lessmann and R. E. Gold *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 39–73 refs (See N71-13301 03-17)

(Contract NAS3-2540)

Avail: NTIS CSCL 11F

The thermal stability of refractory metal alloys which showed promise for application in high temperature space power systems was determined. Only the very fabricable columbium and tantalum base alloys were evaluated. T-111, T-222, and FS-85 eventually received the greatest emphasis because they demonstrated a superior balance of creep strength, weldability, and liquid metal corrosion resistance when evaluated in concurrent programs. The alloys were thoroughly evaluated before and after aging to ascertain if degradation of mechanical properties occurred or if structural instability was otherwise noted. Bend testing for ductility changes as reflected in the bend transition temperature was emphasized as a screening technique. Considerable success was achieved using this procedure since changes in ultimate ductility and transition behavior reflect a wide spectrum of structural interactions. Tensile testing, hardness determinations, and extensive optical and electron metallography were also employed. Electron beam and gas tungsten arc welds were evaluated as well as base metal. Author

N71-13305*# TRW Equipment Labs., Cleveland, Ohio.

CREEP BEHAVIOR OF REFRACTORY ALLOYS IN ULTRAHIGH VACUUM

K. D. Sheffler, J. C. Sawyer, and E. A. Steigerwald *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 75–125 refs (See N71-13301 03-17)

(Contracts NAS3-2545; NAS3-9439)

Avail: NTIS CSCL 11F

Several Cb, Ta, Mo, and W base alloys have been creep tested with both constant and continuously increasing loads in a vacuum environment at temperatures and stresses chosen to provide between 1/2 and 1 percent creep in times up to 20,000 hours. Isostatic design data are presented in the form of a Larson–Miller plot for 1/2 or 1 percent creep life for each of these refractory alloys. Elevated temperature tension test data from the tantalum base alloy T-111 showed a strain aging reaction in the 1400 to 2200 F range which produced an unusual transient creep behavior. Analysis of the isostatic steady state creep data for this material showed that the isostatic steady state creep of T-111 is governed by a diffusion controlled microcreep mechanism rather than by nonconservative dislocation motion. The creep tests which were run on T-111 alloy with continuously increasing loads provided continuously increasing creep rates which were comparable to the isostatic steady state creep rates at equivalent stress levels. Methods have been developed for prediction of the 1 percent creep life under varying stress conditions from isostatic creep test data, and comparison of these predictions with the experimental results shows the dependence of analytical techniques on the character of the isostatic creep curves. Author

N71-13306*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

EFFECT OF HEAT TREATMENT ON CREEP PROPERTIES OF THE TANTALUM BASE ALLOY ASTAR-811C

D. L. Harrod and R. W. Buckman, Jr. *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 127–142 (See N71-13301 03-17)

(Contract NAS3-10939)

Avail: NTIS CSCL 11F

ASTAR-811C has the nominal composition Ta-8W-1Re-0.7Hf-0.025C and thus contains both solid solution and dispersed phase strengthening features. Investigated were the response of ASTAR-811C to heat treatment and the associated changes in mechanical properties. Specimens were heat treated for times of 5 to 60 minutes at temperatures between 3000 and 3800 F, and their creep properties and microstructures were evaluated. Author

N71-13307*# TRW Equipment Labs., Cleveland, Ohio.
HIGH FREQUENCY FATIGUE PROPERTIES OF TZC AND T-111 ALLOYS
E. A. Steigerwald, K. D. Sheffler, and J. C. Sawyer *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 143–164 refs (See N71-13301 03-17)
(Contract NAS3-6010)
Avail: NTIS CSCL 11F

High frequency fatigue tests were conducted in an ultrahigh vacuum environment on recrystallized molybdenum base alloy TZC and tantalum base alloy T-111 at temperatures between 1800 and 2200 F. The results indicated that in this temperature range no well-defined endurance limit existed for either material. The application of a cyclic load to a statically-loaded specimen produced a marked acceleration in the degree of specimen extension. In both the TZC and T-111 alloy the increase was characterized by a relatively rapid first stage creep extension (on the order of 1 to 10 percent) compared to the very small extensions (less than 0.01 percent) observed at the same temperatures and peak stresses in the isostatic creep tests. In the TZC alloy the dynamic loading increased the steady state creep rate by approximately two orders of magnitude; however, this acceleration was not observed for the T-111 alloy. Possible reasons for this behavior are discussed in terms of previous observations concerning the isostatic creep behavior of these materials. Author

N71-13309*# General Electric Co., Cincinnati, Ohio.
T-111 ALLOY CRACKING PROBLEMS DURING PROCESSING AND FABRICATION
R. A. Ekvall, R. G. Frank, and W. R. Young *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 221–260 refs (See N71-13301 03-17)
(Contracts NAS3-6474; NAS3-9426)
Avail: NTIS CSCL 11F

A review is made of T-111 cracking encountered during fabrication of advanced space power Rankine cycle system components since 1965. Cracking has been observed after machining, forming, and welding. A majority of crack incidents have been associated with welding. Although tungsten inert gas welding is the primary joining technique used, cracks have also been found after electron beam and spot tack welding. Cracking phenomena associated with each fabrication method are described with emphasis on weld related cracking. Preventative measures adopted for each type of cracking are reviewed. Possible causes for cracking, including attempts at correlating cracking incidents with material properties and processing history, are discussed. The frequency of crack occurrences and the requirements for highly reliable system components indicate the need for an investigation of the basic mechanism(s) underlying T-111 alloy cracking. Author

N71-13310*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
WELDABILITY OF TUNGSTEN BASE ALLOYS
G. G. Lessmann and R. E. Gold *In* NASA. Lewis Res. Center Recent Advan. in Refractory Alloys for Space Power Systems 1970 p 261–286 refs (See N71-13301 03-17)
(Contract NAS3-2540)
Avail: NTIS CSCL 11F

The weldability of unalloyed tungsten and two tungsten alloys was evaluated. The alloys were W-25Re (wt%) and W-25Re-30Mo (at.%). These were evaluated as arc cast material and for the ternary alloy also as a powder metallurgy product. The most important aspect of welding unalloyed tungsten was that it is very sensitive to thermal shock. High preheat temperatures (to 1400 F) alleviated this problem. W-25Re had improved thermal shock resistance but was shown to be basically hot tear sensitive in gas tungsten arc welding. Preheat temperatures of 1400 F were again beneficial. The powder metallurgy W-25Re-30Mo alloy displayed excellent weldability, whereas the arc cast material displayed extensive hot tearing and, hence, poor weldability. The anomalous hot tearing behavior of the arc cast W-25Re-30Mo alloy was ascribed to a very high sensitivity to oxygen contamination. The effects of postweld annealing, joint preparation, and aging for 1000 hours at temperatures to 3000 F were evaluated. The high temperature tensile strength of base metal, gas tungsten arc welds, and electron beam welds in W-25Re-30Mo was determined. Author

N71-13334# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICOCHEMICAL THEORY OF HEAT RESISTANCE AND NEW HEAT-RESISTANT TITANIUM ALLOYS
I. I. Kornilov et al 2 Jul. 1970 18 p refs Transl. into ENGLISH of the book "Fiziko-Khimicheskie Issledovaniya Zharoprochnykh Splavov" Moscow, Nauka, 1968 p 57–64
(AD-712810; FTD-HT-23-286-70) Avail: NTIS CSCL 11/6

In accordance with the developed physicochemical theory of heat resistance and the four basic types of equilibrium diagrams, four types of diagrams of phase vs heat resistance of titanium systems were developed. Binary titanium systems are distributed among these four types according to the character of influence of the elements on the heat resistance of titanium. The established principles of change in the heat resistance as a function of the composition and structure of binary titanium systems are valuable for research on multicomponent titanium systems and for establishing the optimal compositions for new heat-resistant titanium alloys. On the basis of these principles, in the multicomponent systems Ti-Al-Zr-Sn, Ti-Al-Zr-Mo-Fe, Ti-Al-Zr-Sn-Mo, compositions for the new heat-resistant alloys ST-1, ST-3, ST-4, and ST-5 were established. The alloys ST-1 and ST-3 have high short-term strength up to 600 degrees, and alloys ST-4 and ST-5 - up to 800 degrees. The stress-rupture strengths at 600 degrees for 100 hours are: for ST-1 - 25.5 kgf/sq mm, for ST-3 - 16.5 kgf/sq mm, and for ST-4 - 33 kgf/sq mm. The alloy ST-5 has a stress-rupture strength for 100 hours at 700 degrees equal to 20 kgf/sq mm. Author (TAB)

N71-13348# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Research Div.
THE PREPARATION AND CHARACTERIZATION OF ELECTRON BEAM, VAPOR DEPOSITED, GERMANIUM FILMS
Charles Sterling Portwood, III (M.S. Thesis) Apr. 1970 71 p refs
(Contract W-7405-eng-48)
(PB-193261; UCRL-19164) Avail: NTIS CSCL 14B

The origin of this study lies in the desire of other experimenters to investigate the chemistry of a liquid (germanium)-vapor (iodine) system using a molecular beam machine. The purpose of the study discussed was to determine the feasibility of using a liquid germanium film, plated on the surface of a graphite or molybdenum substrate, as a target in the molecular beam machine. It was concluded that neither graphite nor molybdenum is a suitable substrate material. Author (USGRDR)

N71-13364# National Aerospace Lab., Amsterdam (Netherlands).
ELECTRON FRACTOGRAPHY OF FATIGUE IN A HIGH STRENGTH STEEL
D. Broek and W. J. van der Vet Mar. 1969 34 p refs Sponsored by Roy. Neth. Air Force
(NLR-TR-69043-U) Avail: NTIS

An extensive electron fractographical investigation was carried out of a series of fatigue failures in a 4340 type steel. Low tempering temperatures and low stresses promote intergranular fatigue fractures. High stresses and high tempering temperatures promote the formation of striations. Author (ESRO)

N71-13367# Boeing Co., Renton, Wash. Commercial Airplane Div.
DEVELOPMENT OF A HIGH STRENGTH STAINLESS STEEL

WITH IMPROVED TOUGHNESS AND DUCTILITY
D. Webster 15 Sep. 1970 38 p refs
(AD-712724; D6-25443) Avail: NTIS CSCL 11/6

Compositional modifications were made to the existing Cr-Mo-Co stainless steels to produce a steel (alloy B) which combines the high strength of AFC 77 with the toughness of AFC 260. This was achieved by utilizing both the strengthening effect of grain refinement and the crack stopping ability of retained austenite. After tempering at 800-900F alloy B possesses higher uniform elongation than other high strength stainless steels due to the ease with which its retained austenite transforms under stress to martensite to delay necking. An explanation is advanced for the anomalously low tensile yield strength that occurs in both alloy B and AFC 77 after tempering at 1000F. Author (TAB)

N71-13397# Naval Research Lab., Washington, D.C.
ARPA COUPLING PROGRAM ON STRESS-CORROSION CRACKING Final Technical Report
B. F. Brown 21 Sep. 1970 192 p refs
(ARPA Order 878)
(AD-713059; NRL-7168) Avail: NTIS CSCL 11/6

The technical background, organization, and modus operandi of the ARPA coupling program on stress-corrosion cracking are summarized. The problem of interpreting the data from smooth stress-corrosion cracking specimens is discussed. This is followed by a summary of technical achievement highlights in narrative from treating specimen types, titanium alloys, high strength steels, aluminum alloys, and surface sciences. An Abstracts of Achievements section (abstract arranged by organization) is the most important part of this report, for it gives not only indications of technical contributions but the literature citations where the interested reader can examine the detailed account of a given topical area. The Abstracts of Achievements section includes a subject index. The Program was one of multiple goals, including experimentation involving coupling the Naval Research Laboratory with academic personnel and amplifying NRLs capabilities by the addition of an industrial contractor. Since the personnel report is a purely technical one, it does not treat these nontechnical goals. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N71-12599*# TRW Systems Group, Redondo Beach, Calif.
CADMIUM SULFIDE DEPOSITION STUDY Final Report
J. A. Scott-Monck, R. E. Scott, H. T. Mann, and F. T. Snively 20 Sep. 1970 87 p refs
(Contract NAS3-13224)
(NASA-CR-72608) Avail: NTIS CSCL 07D

Parameters important in obtaining CdS films which are reproducible and useful in the fabrication of solar cells are discussed. Studies were made on both the electrical and physical properties of CdS films. These included conventional x-ray diffraction techniques, optical microscopy, Hall effect, photoconductivity and thermally stimulated current measurements. Reproducible films were made over a wide conductivity range and the importance of source temperature as an independent variable was established. The electrical behavior of CdS films can be interpreted by the inter-crystalline boundary model developed to explain PbS films. Author

N71-12745*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PHYSICAL AND CHEMICAL REACTIONS OF ISOPRENE AND FLUOREL ELASTOMERS BETWEEN −150 C AND 150 C
Joseph H. Judd Washington Dec. 1970 18 p refs
(NASA-TN-D-6116; L-7414) Avail: NTIS CSCL 07D

Differential thermal analysis measurements were made on two elastomers which have been proposed for spacecraft application, isoprene elastomer and a closed-cell Fluorel foam, over a temperature range from −150 C to 150 C at pressures of 100 kN/sq m and 2 N/sq m. A subzero chemical reaction in both elastomers was indicated on the thermograms and by the generation of an effluent which was identified as water vapor. A glass transition temperature of −62 C was shown for isoprene elastomer but a definite transition for Fluorel could not be established. Author

N71-12814# Battelle-Northwest, Richland, Wash. Fuels and Materials Dept.
SURFACE TENSION AND DENSITY OF MOLTEN ALUMINA
Jewell J. Rasmussen and Richard P. Nelson 22 Jul. 1970 18 p refs Submitted for publication
(Contract N00014-67-C-0341)
(AD-711984; BNWL-SA-3346; TR-3) Avail: NTIS CSCL 11/2

An x-radiographic technique was used to obtain profiles of molten Al2O3 menisci and pendant drops sealed in molybdenum or tungsten capsules. The surface tension was found to be 574 dynes/cm from the pendant drop shape and 360 dynes/cm and 638 dynes/cm from the meniscus shape technique in molybdenum and tungsten capsules, respectively. The density was found to be 2.92 g/cu cm at the melting point. Author (TAB)

N71-12815*# IIT Research Inst., Chicago, Ill. Technology Center.
THE BEHAVIOR OF SEVERAL WHITE PIGMENTS AS DETERMINED BY IN SITU REFLECTANCE MEASUREMENTS OF IRRADIATED SPECIMENS
G. A. Zerlaut and F. O. Rogers [1970] 47 p refs
(Contracts NAS8-5379; NAS8-21074)
(NASA-CR-102930) Avail: NTIS CSCL 11C

The behavior of several white pigments as determined by in situ reflectance measurements of irradiated specimens° materials research is reviewed relating primarily to two white pigment materials: zinc oxide and zinc orthotitanate. The zinc oxide studies include (1) investigation of the photodesorption problem associated with the irradiation of zinc oxide in vacuum, (2) elucidation of the resultant and concommittant generation of an infrared-centered absorption band, and (3) prevention of the development of photodesorption-related infrared absorption by treating the zinc oxide surface with alkali silicates. The zinc orthotitanate studies relate to (1) the synthesis of zinc titanates having various controlled stoichimetry and optical properties, (2) the relation between heat treatment and stability to ultraviolet irradiation in vacuum, and (3) the photodesorption phenomena associated with zinc titanates. Author

N71-13013# Sandia Corp., Albuquerque, N.Mex.
STRUCTURE OF CARBON FIBERS
Angeline Fourdeux et al 21 Jul. 1970 6 p refs Transl. into ENGLISH from Compt. Rend., Ser. C, v. 269, 1969 p 1597–1600
(SC-T-70-4030) Avail: NTIS

The present state of knowledge regarding the structure of carbon fibers is summarized and a model is described which agrees with the results obtained by various experimental techniques. Author

N71-13017*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF SPACECRAFT MATERIALS THAT SUPPORT MICROORGANISM GROWTH Summary Report, 1 Sep. 1968 – 30 Jun. 1970
H. T. Kemp and C. W. Cooper 17 Jun. 1970 57 p ref
(Contract NAS8-30504)
(NASA-CR-111524) Avail: NTIS CSCL 11C

Seventeen coatings were selected as being representative of 166 such materials applied externally on spacecraft. The coatings were applied on aluminum rods and evaluated in the laboratory to determine whether they were resistant to microbial attack and whether nutrients from the coatings were available for the growth of microorganisms. All of the coatings contained nutrients suitable for microbial growth or allowed survival of two or more species studied. Some of the coatings, e.g., fungicide-containing varnishes, a phenolic butyrate, and a polyimide, appear to be somewhat resistant to microbial attack; while epoxy, acrylic, silicone, silicate, and polyurethanes, in decreasing order of resistance, appear to be more susceptible to attack. Microbiocide incorporation into these coatings was recommended for improved inhibition of microorganisms for spacecraft sterilization and for increased protection from deterioration by microorganisms. Author

N71-13054*# Sheffield Univ. (England). Dept. of Glass Technology.
DIELECTRIC PROPERTIES OF GLASS Survey of Research, 1956 – 1967
J. O. Isard London Min. of Technol. Mar. 1969 16 p refs Sponsored by Min. of Technol.
(D-Mat-158) Avail: NTIS

Glasses containing alkalies as major constituents are cationic conductors. Nominally alkali-free glasses of the lead-silicate and bismuth borate types have been shown to conduct by either electronic or protonic mechanisms. It was found that conduction in glasses is not sensitive to the concentration of minor constituents, apart from OH content, and this is not considered to be a general rule with the exception of fused silica glass. Glasses of all compositions exhibit high temperature coefficients of permittivity and are affected by the migration loss mechanism at audio/radio frequencies and elevated temperatures. At microwave frequencies, the distinct vibration loss mechanism is important. Calcium and barium aluminoborate glasses have extremely low conductivities, and low loss factors but the permittivities are only 6-10. Lead aluminoborates, lead silicates, and lead bismuth borates give permittivities ranging up to 30 but the conductivities and loss factors are also higher. Compositions were found which yield lead titanate crystals in a barium borate glass; the materials exhibit permittivities up to over 100 but the loss factors and temperature coefficients are higher than for typical borate glasses. Author

N71-13062*# Naval Research Lab., Washington, D.C.
FRACTURE TOUGHNESS OF FILAMENT-WOUND COMPOSITES. PART 1: EFFECT OF MATERIAL VARIABLES Final Report
Robert J. Sanford and Fred R. Stonesifer 29 Jul. 1970 23 p refs
(AD-713063; NRL-7112) Avail: NTIS CSCL 11/4

The application of the theory of linear fracture mechanics to quasi-brittle, glass-reinforced-plastic composites is an important first step in understanding the basic mechanisms of failure of these materials. In the study, a simple test technique sensitive to small changes in the material and/or environmental variables is developed based on fracture mechanics concepts. Using the stress-intensity factor K sub I c as the evaluating parameter, six different resin-glass combinations were tested. The results of these tests indicate that (a) there is no difference in the fracture strength of composites made with either E-glass or S-glass, (b) composites with 5-mil-diam fibers have a lower resistance to crack propagation than those with conventional 0.4-mil-diam fibers, and (c) a filament-wound composite has a much lower fracture toughness in the B-staged state than in the fully cured state. In another phase of the study, the effect of water immersion was investigated. These tests demonstrate that with the exception of the composite made with the large-diameter (5-mil) fibers there is no systematic decline in fracture strength due to water immersion for periods up to 6 months. Author (TAB)

N71-13123*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUBRICATING AND SIZING AGENT FOR GLASS FIBER
L. V. Golosova et al 28 May 1970 6 p Transl. into ENGLISH from Russian Patent no. 235907 (Appl. no. 1186919/23-5, 24 Jun. 1967) 1 p
(AD-712944; FTD-HT-23-292-70) Avail: NTIS CSCL 11/3

Discussed is a lubricating and sizing agent for glass fibers consisting of poly(vinyl alcohol), sucrose, metal salts, and water. To improve the physicomechanical properties of the glass fiber and of goods manufactured from it, Ti lactate is used as the metal salt. The following composition is recommended: poly(vinyl alcohol) 1.25 to 1.5, sucrose 0.5 to 0.6, Ti lactate 3.5 to 4.0, and water to 100 percent. TAB

N71-13161*# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.
PULSE PROPAGATION IN A LAMINATED MEDIUM
Kirk C. Valanis Sep. 1970 23 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-712376; THEMIS-UI-25) Avail: NTIS CSCL 20/11

The properties of a stratified olastic medium, with respect to propagation of stress pulses in a direction normal to the layers are examined. The medium is found to possess a dispersion curve with passing and stopping bands. If a ringing pulse has a frequency in a stopping band it will not propagate but will quickly attenuate; conversely, if its frequency lies in a passing band it will propagate with a group velocitv correeponding to that particular frequency. The medium resolves ordinary pulses into two classes of ringing pulses, those which propagate and those which attenuate. Thus the energy admittance of the medium can be reduced by suitably narrowing the passing bands. Analytical solutions for propagating and attenuating pulses are given. Author (TAB)

N71-13181*+ Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OIL ADDITIVES: SELECTED ARTICLES
I. F. Blagovidov et al 14 Jul. 1970 579 p refs Transl. into ENGLISH from the Publ. Trudy 2d Vsesoyuznoye Nauchno-Teknicheskoye Soveschaniye po Prisadkam k Maslam, Baku, 1966' Moscow, Izd.-Vo, 1968 p 7-77, 96-108, 115-159, 167-168, 178-189, 194-219 224-250, 306-314, and 324-333
(AD-712830; FTD-HC-23-269-69) Avail: NTIS CSCL 11/9

The report discusses the results of research in the synthesis of new additives, development or improvement of production technology, the study of the mechanisms by which additives act, and also the results of research on the effectiveness of additives and their combinations in motor oils, insulating oils, power machinery oils, and other oils. Several new additives, which have been thoroughly investigated and tested by scientific research organizations and motor works, are recommended for industrial production, which should further improve the operational properties of oils. The production of additives and their combinations has been increased significantly. At the same time, a discussion of the reports shows that there are still many deficiencies in developing high-performance additives, in the technology of their production, and in their rational applications. Author (TAB)

N71-13182*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF A THEORETICAL ULTIMATE

COMPRESSION STRENGTH OF REINFORCED MATERIALS
O. M. Guz 15 Jun. 1970 10 p refs Transl. into ENGLISH from Akad. Nauk URSR, Kiev, Dopovidi. Ser. A Fiz-Tekhnichni Ta Matematichni Nauki (USSR), v. 31, no. 3, 1969 p 236–238
(AD-712937; FTD-HC-23-197-70) Avail: NTIS CSCL 11/4

Determination of the theoretical compression strength of reinforced materials, assuming that the Youngs moduli of the material components differ appreciably from each other. The stress components that are appreciably greater than the rest are assumed to act along the fibers of fiberglass-reinforced materials or along the layers of sandwich materials. The compression strength, expressed in the microcharacteristics of the material, is determined from the nonlocal changes in the microvolume. It is shown that failure occurs along the planes normal to direction of the compressive force. Author (TAB)

N71-13254# Explosives Research and Development Establishment, Waltham Abbey (England).
FIBRE-FILLED THERMOPLASTICS. PART 1: ASBESTOS
B. E. Brokenbrow, B. L. Hollingsworth, K. J. Ledbury, and D. Sims Dec. 1969 36 p refs
(ERDE-TR-2) Avail: NTIS

Graded and ungraded chrysotile and amosite asbestos fibers were examined as reinforcing fillers for thermoplastics. Methods of incorporating the fiber were examined and the effects of incorporation and processing on the fiber length were studied. The tensile properties of the asbestos fiber reinforced materials were measured and compared with those of glass reinforced materials. Author (ESRO)

N71-13390# Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering.
MECHANISMS OF STRUCTURAL TRANSFORMATION IN AMORPHOUS SOLIDS STUDIED BY X-RAY SCATTERING TECHNIQUES
Robert W. Gould and Larry L. Hench 30 Sep. 1970 89 p refs
(Contract N00014-68-A-0175-0006)
(AD-712612; TR-1) Avail: NTIS CSCL 11/2

The research is investigating thermally dependent structural changes occurring in glasses using x-ray r.d.f. and I.R. techniques. Recent improvements in x-ray theory and technique using pair function analysis has extended the limit of structural resolution to 3rd nearest neighbors and permits the evaluation of bond length and bond angle distributions. Structure-property correlations in vitreous silica are being carried out by stressing glass samples in the x-ray apparatus. The report discusses the results obtained in the first year of research under the Grant. Author (TAB)

N71-13391# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Mathematik und Physik.
OPTICAL AND PHOTOELECTRIC PROPERTIES OF THIN CESIUM OXIDE FILMS [OPTISCHE UND PHOTOELEKTRISCHE EIGENSCHAFTEN DUENNER CAESIUMOXYDSCHICHTEN]
Ernst-Ludwig Hoene (Ph.D. Thesis) 1970 87 p refs In GERMAN
Avail: NTIS

The optical and emission properties of cesium oxide films of 1000 A thickness on the substrates glass, silver, and palladium, are investigated. The results are used for the interpretation of the photoelectric emission properties of technical cesium oxide cathodes. ESRO

N71-13400# Air Force Systems Command Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTIOXIDANT ADDITIVE FOR HYDROCARBON OILS
S. I. Gaft et al 11 Aug. 1970 7 p Transl. into ENGLISH from Russian Patent no. 233818 (Appl. no. 1168409/23-4, 26 Jun. 1967) 2 p
(AD-713046; FTD-HT-23-388-70) Avail: NTIS CSCL 7/3

The use of Ionol (2,6-di-tert-butyl-4-methylphenol) as an antioxidant additive to hydrocarbon oils is known. It is proposed that derivatives of beta-hydroxinepropionic acids of the following general formula be used as an antioxidant additive to hydrocarbon oils: H2NN (R)CH (RI)CH (R2)COOH where R, RI, R2 are H, CH3, C6H5 respectively. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N71-12593# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MATHEMATICAL METHODS IN THE THEORY OF RELIABILITY; BASIC CHARACTERISTICS AND THEIR STATISTICAL ANALYSIS
B. V. Gnedenko et al 12 Jun. 1970 612 p refs Transl. into ENGLISH of the book 'Matematicheskiye Metody v Teorii Nadezhnosti; Osnovnyye Kharakteristiki Nadezhnosti i ikh Statisticheskiy Analiz' Moscow, Izd. Nauka, 1965 p 1–524
(AD-712949; FTD-MT-24-51-70) Avail: NTIS HC $10.00/MF $0.65 CSCL 14/4

The book presents basic concepts of the mathematical methods in the theory of reliability and gives various plans for estimating characteristics of reliability from the results of tests. Also, methods for testing the hypothesis, the theory of reservation without reduction and with reduction, and methods of acceptance control are presented. The book contains supplementary tables. In the first chapter is an introduction to the theory of probability, mathematical statistics and Laplace transform. The book is recommended for mathematicians, engineers and students dealing with problems in the theory of probability. The section of the book concerning quality control of production is useful to those working in the field of technical control. Author (TAB)

N71-12681# Hawaii Univ., Honolulu.
ON THE SOLUTION OF LINEAR ALGEBRAIC SYSTEMS BY MATRIX DECOMPOSITION
Nai-kuan Tsao and Franklin F. Kuo Jul. 1970 24 p refs
(Contract F44620-69-C-0030; Proj. Themis)
(AD-712680; Themis-A-70-12; AFOSR 70;2494TR) Avail: NTIS CSCL 12/1

A theorem is proved which states that the inverse matrix A sup(-1)sub n of any nonsingular matrix A sub n could be expressed as a unique sequence of U sup(i)sub n D sup(i)sub n L sup(i)sub n products where D sup(i)sub n is an n-th order diagonal matrix, U sup(i)sub n is a special n-th order upper triangular matrix, L sup(i)sub n is a special n-th order lower triangular matrix and i runs from 1 up to n. It is also shown that the inverse of each principal minor matrix A sub k with det(A sub k) not = 0 is also generated in product form. Furthermore the non-zero column above the diagonal of each U sup(i)sub n is the solution of the system A sub(i-1)Xsub(i-1)+Csubi=0 where C sub i = (a sub K,i), 1 < or = k < or = (i-1). The associated algorithm is described together with considerations on storage arrangement, pivoting and operational counts. Finally an example is given in the Appendix. Author (TAB)

N71-12761# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
ON TWO CLASSES OF TEST MATRICES
Nai-Kuan Tsao Jul. 1970 14 p refs
(Contract F44620-69-C-0030)
(AD-712679; AFOSR-70-2491TR; TR-A70-11) Avail: NTIS CSCL 12/1

Two classes of matrices which are useful in testing numerical algorithms for problems in linear algebra are presented. Their determinants, eigenvalues, eigenvectors and inverses are deduced in analytic forms. These are easily generated by machine or by hand as functions of certain parameters in the original matrices. By appropriately selecting the parameters one is able to generate ill-conditioned matrices without having to deal with high order matrices. Author (TAB)

N71-12800# Rice Univ., Houston, Tex. Aero-Astronautics Group.
NUMERICAL SOLUTIONS IN THE SIMPLEST PROBLEM OF THE CALCULUS OF VARIATIONS
Angelo Miele and Robert E. Pritchard Oct. 1970 31 p refs
(Grant AF-AFOSR-0828-67)
(AD-712543; AAR-71; AFOSR-70-2502TR) Avail: NTIS CSCL 12/1

The paper discusses numerical techniques for solving the simplest problem in the calculus of variations. Both first-variation methods and second-variation methods are reviewed. Author (TAB)

N71-12816# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
FINITE ELEMENT METHOD FOR ELLIPTIC DIFFERENTIAL EQUATIONS
Ivo Babuska May 1970 42 p refs Presented at the Symp. on the Numerical Soln. of Partial Differential Equations, College Park, Md., 11–15 May 1970
(Contract AT(40-1)-3443)
(ORO-3443-25; CONF-700526-1; BN-653) Avail: NTIS

An investigation of different aspects of the finite element method is presented. One approach aimed especially at solving elliptical equations is analyzed. The results are explained and numerical experiments for simple model problems are presented. Topics covered in the analysis include: (1) approximation theory in R sub n; (2) boundary value problems with natural boundary conditions; (3) boundary value problems with Dirichlet boundary conditions; (4) boundary value problems with natural boundary conditions and singularities on the boundary; and (5) solutions of the Dirichlet problem by the perturbed variational principle. D.L.G.

N71-12817# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Operations Research.
CAPITAL BUDGETING-PROJECT SELECTION BY MATHEMATICAL PROGRAMMING: AN ANNOTATED BIBLIOGRAPHY
Roy B. Larson Jan. 1970 170 p refs
(TM-173) Avail: Issuing Activity

A comprehensive survey of literature relevant to the application of mathematical programming methods in corporate planning is presented. Continual reference is made to three subjects: (1) the Lorie-Savage problem; (2) the Hirshleifer paradox; and (3) the Markowitz criteria. D.L.G.

N71-12904# Royal Aircraft Establishment, Farnborough (England).
A METHOD OF CALCULATING SAMPLING ERRORS
T. D. Reed and J. W. Lloyd Aug. 1969 40 p refs
(RAE-TR-69170) Copyright. Avail: NTIS

Errors are introduced when an analogue signal is reconstructed from its sample values. These errors are due to the aliasing effect, and to distortion of the data spectrum by the interpolation filter. Methods for calculating the errors are described and computer results obtained for the case where both the data spectrum and the interpolation filter characteristic are of the Butterworth form. The computer programs, which are in FORTRAN 4 were written so that they can readily be adapted to cater for other cases. Author

N71-12998# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.
FILTERING AND SMOOTHING OF BOUNDARY AND INTERIOR MEASUREMENT DATA FOR DISTRIBUTED PARAMETER SYSTEMS
J. S. Meditch Sep. 1970 22 p refs
(AD-712404; D1-82-0995; Rept-28) Avail: NTIS CSCL 12/1

Four theorems characterizing optimal filtered and smoothed estimates for linear parabolic systems are presented. The models considered include the effects of internal system noise as well as measurement noise. Cases involving measurement data given either on the systems boundary or over its interior are examined. The two theorems on optimal filtering represent extensions and refinements of earlier work; the two theorems on optimal smoothing are new. Author (TAB)

N71-13088# Royal Aircraft Establishment, Farnborough (England).
ON SOME DEVELOPMENTS IN THE STUDY OF PROCESSES FOR SOLVING ORDINARY DIFFERENTIAL EQUATIONS
R. H. Merson Aug. 1969 12 p refs
(RAE-TM-Space-126) Avail: NTIS

A dynamical system with a wide range of time constants presents difficulties when numerical integration procedures are used for analysis. A method for solving sets of ordinary differential equations using a digital computer is presented. Author

N71-13184# Stanford Univ., Calif. Operations Research House.
THE LINEAR COMPLEMENTARITY PROBLEM IN COMPLEX SPACE
Charles J. McCallum, Jr. Aug. 1970 119 p refs
(Contract N00014-67-A-0112-0011)
(AD-712769; TR-70-12) Avail: NTIS CSCL 12/2

Duality theorems for linear and quadratic programming have recently been extended to complex space by Levinson and by Hanson and Mond. In real space, linear and (convex) quadratic programs can be unified by the Linear Complementarity Problem (LCP) for which pivoting algorithms are available. In this paper, a similar result is sought for complex space. The Complex LCP is formulated and then investigated from both existential and constructive points of view. The duality results of complex linear and quadratic programming are reviewed and the Complex LCP that is formulated is shown to give complex linear and quadratic programs as special cases. An existence theory is developed by means of complex versions of an alternative theorem, the Frank-Wolfe Theorem, and the Kuhn-Tucker Theorem. Various invariance theorems for principal pivoting in complex space are given. It is shown that the Complex LCP can not be solved by a natural pivoting algorithm in complex space; however, a transformation of the problem enables one to solve it (and hence complex linear and quadratic programs) by means of real space pivoting theory. An example which utilizes this solution procedure is given in the Appendix. Author (TAB)

N71-13185# Colorado Univ., Boulder. Dept. of Mathematics.
THE STRUCTURE OF ATTAINABLE SETS Final Scientific Report, 1 Jan. 1967 – 31 Jul. 1970
Henry Hermes Sep. 1970 17 p refs
(Grant AF-AFOSR-124-67)
(AD-712737; AFOSR-70-2473TR) Avail: NTIS CSCL 12/1

The report contains a chronological listing of scientific publications and a summary of results, obtained under the grant. The main object of this study was the attainable set, i.e. the set of states attainable by all solutions, of a control system or more generally a generalized differential equation. The summary is divided into three sections: Existence of Solutions; Properties of Solutions and the attainable set; Techniques of approximation and calculation. A summary of all known results on the question of existence of solutions is given, with a description of how they

overlap and fit together. Next, the known properties of the set of all solutions under various conditions, such as convexity of the right sides or Lipschitz continuity, etc. are listed, again with a discussion of their overlap and reference to where complete proofs can be found. Finally, the outline of approximation techniques is given. In short, this report summarizes the current state of knowledge in the theory of generalized differential equations and their attainable sets; many of the results being obtained under sponsorship of this grant. Author (TAB)

N71-13186# Illinois Univ., Urbana. Coordinated Science Lab.
A SUBOPTIMAL NONLINEAR ESTIMATOR FOR SYSTEMS WITH UNKNOWN PARAMETERS
Richard Stanton Brownell Jun. 1970 54 p refs
(Contract DAAB07-67-C-0199)
(AD-712894; R-472; UILU-eng-70-217) Avail: NTIS CSCL 12/1

An algorithm is presented which provides a maximum likelihood estimate for an unknown parameter contained in a linear-dynamic system driven by white, gaussian noise. The observations of the system are also corrupted by white noise. Taylor series expansions are used to develop approximations to the estimation equations. These approximations are recursive and can be calculated iteratively. The algorithm can be realized either as an analog or as a digital system and is shown to compare favorably with existing techniques in a simple example. Author (TAB)

N71-13187# Iowa State Univ. of Science and Technology, Ames.
PARALLEL TANGENTS AND STEEPEST DESCENT OPTIMIZATION ALGORITHM: A COMPUTER IMPLEMENTATION WITH APPLICATION TO PARTIALLY LINEAR MODELS Interim Report
T. Papaioannou and O. Kempthorne Wright-Patterson AFB, Ohio ARL Jul. 1970 51 p refs
(Contract F33615-68-C-1343)
(AD-712401; ARL-70-0117) Avail: NTIS CSCL 12/1

The report presents a computer implementation of the PARTAN and steepest descent optimization algorithms. Some research on fitting partially linear models is also reported. Chapter I gives an introduction to the PARTAN and steepest descent optimization algorithms. Chapter II describes the problems solvable by the present routine. Chapter III presents an analysis of the program. Input-output considerations, data preparation and limitations of the program are given in Chapter IV. Results of test problems and a list of error messages are given in Chapters V and VI respectively. The fitting of non-linear models is discussed in Chapter VII. Finally, a listing of the computer program is given in the Appendix. Author (TAB)

N71-13232# RAND Corp., Santa Monica, Calif.
WHAT IF UTILITY FUNCTIONS DO NOT EXIST?
Fred S. Roberts Sep. 1970 35 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-712762; R-528-ARPA) Avail: NTIS CSCL 12/2

The document discusses alternatives to the strict decisionmaking goal of ranking all alternatives or, equivalently, obtaining a utility function. For many military problems, the best information available is the combined judgements of experts. Often, however, the preferences of decisionmakers are too inconsistent or ambiguous to permit a complete ranking of alternatives or a utility function. Optional methods for dealing with such a situation include finding a procedure through which preferences can be modified to obtain a utility function; using the utility assignment that best approximates a utility function; or modifying the demands on utility functions. The study emphasizes the third alternative, and describes it in terms of techniques from the theory of measurement, recently developed by behavioral scientists, that facilitate decisionmaking where no utility functions exist. TAB

N71-13233# California Univ., Los Angeles. Dept. of Mathematics.
A THEOREM AND COUNTEREXAMPLE IN THE THEORY OF SEMI-GROUPS OF NONLINEAR TRANSFORMATIONS
Michael G. Crandall and Thomas M. Liggett Sep. 1970 37 p refs
(Contract AF-AFOSR-1781-69)
(AD-712808) Avail: NTIS CSCL 12/1

The paper studies the basic method in current use for constructively obtaining a generator from a given semi-group of nonlinear transformations on a Banach space. The method is shown to succeed in real two-dimensional Banach spaces and to fail in a particular three-dimensional example. Other results of independent interest are obtained. For example, it is shown that the concepts of maximal accretive and hyperaccretive (equivalently, m-accretive or hypermaximal accretive) coincide in R sup n with the maximum norm. Author (TAB)

N71-13240# Harry Diamond Labs., Washington, D.C.
A NEW METHOD FOR APPROXIMATING CERTAIN FUNCTIONS AND ITS APPLICATION TO CRITICAL PHENOMENA
Nick Karayianis May 1970 21 p refs
(AD-712972; HDL-TR-1489) Avail: NTIS CSCL 12/1

A method is derived for obtaining approximants to real-values, bounded functions f(t) over 0= or < t = or < infinity. The k,mth approximant to f(t) is of the form (g sub km)(t)= 1/t((Summation, mu= 1 to m)(Summation, n= 1 to k) of the quantity (a sub n)(s sub nu) ((t/((s sub nu)+t)) to the nth power)), and it is constructed so that its expansions about t = 0 and t = infinity coincide with the expansions of f(t) for the first k terms about t = 0 and the first m terms about t = infinity. The method is useful for obtaining very accurate approximants to functions for computer applications and for inferring the behavior of physical quantities that are known only for very small and very large values of their arguments. Author (TAB)

N71-13246# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.
TIME SERIES ANALYSIS AND STATISTICAL METEOROLOGY Final Technical Report, Oct. 1963–Jul. 1970
Leon Jay Gleser 31 Jul. 1970 22 p refs
(Contract AF 49(638)-1302)
(AD-712736; AFOSR-70-2470TR) Avail: NTIS CSCL 12/1

A brief account is given of significant research work carried out under the contract. Also included are a list of publications and technical reports wholly or partially supported by the contract, and a list of papers and talks presented at various scientific meetings. The principal research effort carried out under this contract was in the areas of statistical inference and data analysis for time series. Particular attention was paid to the non-stationary, non-linear time series models that are important in meteorology, geophysics, and other areas of scientific research. Contributions were made in spectral estimation, hypothesis testing, and prediction for stationary and non-stationary multivariate time series, and for random fields. A major new book Multiple Time Series was compiled by Professor E. J. Hannan under partial support of the contract. Additional contributions in sample survey, multiple comparisons, multivariate statistical analysis, control theory, sequential estimation theory, and general probability theory also were made under the contract. Author (TAB)

N71-13255# National Physical Lab., Teddington (England). Div. of Electrical Science.
WALSH FUNCTIONS AS SOLUTIONS OF A LOGICAL DIFFERENTIAL EQUATION
J. E. Gibbs and Margaret J. Millard Dec. 1969 11 p refs
(NPL-DES-1) Copyright. Avail: NTIS

Most well-known sets of orthogonal functions are solutions of linear ordinary differential equations. The Walsh functions, important in the sequencing theory of communications, are apparently an exception. An analog for these functions of the defining differential equation is formulated via an appropriate generalization of the concept of derivatives. Author (ESRO)

N71-13268# Hamburg Univ. (West Germany). Fachbereich Mathematik.
COHOMOLOGY OF FINITE GROUPS [ZUR KOHOMOLOGIE ENDLICHER GRUPPEN]
Juergen Rohlfs (Ph.D. Thesis) 1970 35 p refs In GERMAN
Avail: NTIS

If A is an Abelian group, on which the group G operates, the homology and cohomology groups of A with coefficients A, Tor Z (G) (A; Z) and Ext Z (G) (Z; A) depend functorially on group G. If G is finite, the cohomology groups of G may be formed. The functoriality of these groups and of a short exact sequence of G-modules, belonging to a long exact cohomology sequence of variables G, is investigated. ESRO

N71-13269# Hamburg Univ. (West. Germany). Fachbereich Mathematik.
UNIQUENESS-THEOREMS FOR THE NONLINEAR APPROXIMATION IN STRICTLY CONVEX SPACES [EINDEUTIGKEITSSAETZE BEI DER NICHTLINEAREN APPROXIMATION IN STRIKT-KONVEXEN RAEUMEN]
Juergen Spiess (Ph.D. Thesis) 1969 70 p refs In GERMAN
Avail: NTIS

It is shown that under real non-rigid conditions the best approximation, in the sense of the chosen standard, is unique if the distance function has an adequately small value in its minimum. ESRO

N71-13328# Hamburg Univ. (West Germany). Fachbereich Mathematik.
ASYMPTOTIC BEHAVIOR AND ERROR ANALYSIS FOR A CLASS OF LINEAR INTEGRAL DIFFERENTIAL DIFFERENCE EQUATIONS AS A CONSEQUENCE OF MONOTONIC PROPERTIES OF NORMAL INITIAL VALUE PROBLEMS [ASYMPTOTISCHE AUSSAGEN UND FEHLERABSCHAETZUNGEN FUER EINE KLASSE LINEARER INTEGRO-DIFFERENTIAL-DIFFERENZGLEICHUNGEN ALS FOLGE VON MONOTONIEEIGENSCHAFTEN GEWOEHNLICHER ANFANGSWERTAUFGABEN]
Wilfrid Keller (Ph.D. Thesis) 1970 79 p refs In GERMAN
Avail: NTIS

A general linear integral differential difference equation is analyzed to determine possible error sources as well as its asymptotic behavior, resulting from monotonic properties of normal initial value problems. ESRO

N71-13335# Yale Univ., New Haven, Conn.
UNIVERSAL DYNAMIC FLOW WITHOUT HOLDOVERS
Edward Minieka Sep. 1969 10 p refs
(Grant NSF GS-01692)
(PB-189092, TR-26) Avail: NTIS CSCL 12B

A paper by Gale (1957) proved the existence of a universal dynamic flow for a graph that allows flow units to be held over at a node. A proof, based on Gale's proof, for the existence of a universal dynamic flow for a graph that does not allow flow units to be held over at a node is presented. For the special case when arc capacities and arc transit times are stationary in time in a graph that allows flow units to be held over at a node, it is shown that there exists a universal dynamic flow that does not have any flow units held over at any node. Author (USGRDR)

N71-13354# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UTILIZATION OF TERNARY LOGIC IN CALCULATING NO-FAILURE PROBABILITY OF RESERVED SYSTEMS WITH TWO FORMS OF FAILURES PRESENT
D. N. Kolesnikov 12 Jun. 1970 16 p refs Transl. into ENGLISH from Politekhnicheskii Inst. (Leningrad), no. 291, 1968 p 15-21
(AD-712804; FTD-MT-24-68-70) Avail: NTIS CSCL 12/1

As some circuit elements (resistors, capacitors, diodes) may have three states - operable, short-circuit, and break - a ternary logic is well suited to describe their reliability. Reliability probabilistic formulas in ternary notations are written. Five examples of series-parallel circuits illustrate the use of the formulas. It is found that: the reliability of a system, in which every element is provided with a reserve element, can be calculated by means of a binary logic if short-circuits and breaks are taken into account separately. The ternary system permits calculating the reliability of the structure as a whole. The binary logic is inapplicable to some systems; the ternary logic can be used in such cases. The use of the ternary logic opens the possibility for using an s-nary logic in systems whose elements can exist in one of s states. TAB

N71-13360# Stanford Univ., Calif. Dept. of Statistics.
A CHARACTERIZATION OF THE POISSON DISTRIBUTION BASED ON RANDOM SPLITTING AND RANDOM EXPANDING
Peter C. C. Wang 12 Aug. 1970 22 p refs
(Contract N00014-67:A-0112-0053)
(AD-712758; TR-160) Avail: NTIS CSCL 12/1

Let X be a discrete random variable with parameter lambda = E(x)< infinity and denote B(n,r,a) = (sup n, sub r) (a to the r power) ((1-a) to the (n-r)power). Let the distribution of X be compounded with B(n,r,a). If the resulting distribution is governed by the same law as X, then a characterization of the Poisson distribution is obtained. An alternative proof of the Rao-Rubin characterization is provided. Author

N71-13369# California Univ., Los Angeles. Dept. of Mathematics.
BIFURACATION FROM SIMPLE EIGENVALUES
Michael G. Crandall and Paul H. Rabinowitz [1970] 34 p refs
Prepared in cooperation with Wis. Univ., Madison
(Contract N00014-69-A-0200-4022; Grant NSF GP-21078)
(AD-712438) Avail: NTIS CSCL 12/1

Let G be a mapping of a subset of a Banach space W into a Banach space Y. Let C be a curve in W such that G(C) = (0). A general version of the main problem of bifurcation theory may be stated: Given p epsilon C, determine the structure of G sup (-1) (0) in some neighborhood of p. In this work simple conditions are given under which there is a neighborhood N sub p of p such that (G sup (-1))(0) intersection (N sub p) is topologically (or diffeomorphically) equivalent to the subset [-1,1]x(0) intersection (0)x(-1,1) of the plane, and the first order behavior of G on (G sup (-1))(0) intersection (N sub p) as well as the set itself is studied. The results obtained give a new unity to that part of bifurcation theory commonly called bifurcation from a simple eigenvalue as well as extend its applicability. A broad spectrum of examples is offered, including some generalizations of known results concerning non-linear eigenvalue problems for ordinary and partial differential equations. Author (TAB)

N71-13394# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Mathematik und Physik.
SYMMETRY PROPERTIES OF CYCLOIDS AND ENVELOPE CURVES [SYMMETRIEEIGENSCHAFTEN VON RADLINIEN UND HUELLKURVEN]
Christoph Luebbert (Ph.D. Thesis) 1969 118 p refs In GERMAN
Avail: NTIS

Curves and envelope curves of trochoidal origin are investigated for symmetry. ESRO

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N71-12575# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.

A PRESENTATION, DERIVED FROM THEORY OF COGNITION, OF TOPICAL SYNOPTIC METEOROLOGY PROBLEMS [EINE VOM ERKENNTNISTHEORETISCHEN STANDORT HER ENTWICKELTE DARSTELLUNG AKTUELLER PROBLEME DER SYNOPTISCHEN METEOROLOGIE]

Manfred Geb 1970 130 p refs In GERMAN; ENGLISH summary *Its* Meteorologische Abhandl. Band 111/ Heft 3
Copyright. Avail: NTIS

This paper describes the present situation of synoptic meteorology from three different points of view. Synoptic meteorology is critically analyzed and fundamental questions concerning the theory of fronts and air-masses are discussed. A new hemispheric classification of air-masses is developed from climatological viewpoints and a specific synoptic classification is derived for Europe. A new definition of a front is proposed, which takes into account the typical structure of occluded fronts. Air-mass and front models, similar to those observed, are used in discussing multiple front systems. Author (ESRO)

N71-12596*# National Aeronautics and Space Administration. Electronics Research Center Cambridge, Mass.

SPECTRAL HYGROMETRY PROGRAM, MOUNT HOPKINS, ARIZONA: INSTRUMENTATION AND PROCEDURE MANUAL

Charles R. Vaughn Dec. 1969 25 p ref
(NASA-TM-X-66498; PM-101) Avail: NTIS CSCL 04B

A program to measure total precipitable water vapor and to investigate various correlations between water vapor and local meteorological parameters is discussed. Three interrelated but instrumentally independent sets of measurements include: (1) the ratio of solar flux at a wavelength inside a water vapor absorption band to that at a nearby nonabsorbed reference wavelength, (2) the local pressure, temperature, and dew point temperature, and (3) the atmospheric profile of temperature and relative humidity versus pressure. The instrumentation and general operating procedure for the measurements are described. Author

N71-12625# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.

ARCTIC CLIMATOLOGICAL VARIATIONS [KLIMASCHWANKUNGEN IN DER ARKTIS]

Hans-Detlef Kirch 1970 90 p refs In GERMAN; ENGLISH summary *Its* Meteorologische Abhandl. Band 110/ Heft 4
Copyright. Avail: NTIS

The different amplitudes of the Arctic warming at three stations since the last century were investigated. This warming was particularly marked during the winter months and this winter mildness was greatest at stations with large temperature deviations. The warming of Arctic winters is attributed to an increase of the global solar radiation of about 1.0 per cent which reached its climax in 1938. As the boundary of the Arctic ice sheet had moved far to the north, the cooling of the winters proceeded slowly until 1960. Since 1961 in Spitsbergen and 1957 in Franz Josef Land the winter temperatures have been lower than the mean temperature values for the period 1931 to 1960. Author (ESRO)

N71-12680# Weather Squadron (24th), Detachment 10, Randolph AFB, Tex.

TERMINAL FORECAST REFERENCE FILE, RANDOLPH AIR FORCE BASE, TEXAS Final Report

Sep. 1970 61 p
(AD-712681) Avail: NTIS CSCL 4/2

The reference file discusses factors affecting the weather at Randolph AFB, TX. Included are location and topography, weather controls, climatic aids, local forecast study, special synoptic studies, and rules of thumb. Author (TAB)

N71-12758# Weather Wing (4th), Ent AFB, Colo. Aerospace Sciences Div.

COMPUTERIZED MAP TYPING PROCEDURES AND THEIR APPLICATION IN THE DEVELOPMENT OF FORECAST AIDS

Franklin R. Hartranft, Joe S. Restivo, and Robert C. Sabin Aug. 1970 66 p refs *Its* WW Tech. Paper 70-2
(AD-712678) Avail: NTIS CSCL 4/2

The paper describes methods of classifying surface and upper air weather map into map types through computer techniques, and various applications in the development of forecast aids. Specific emphasis is placed on three applications, namely (1) case studies of special weather phenomenon, (2) objective forecast studies, and (3) synoptic climatological forecast aids. The applications, are illustrated using actual results from several 4 WWg projects. USGRDR

N71-12759# Fraunhofer-Gesellschaft, Garmisch-Partenkirchen (West Germany).

ATMOSPHERIC AEROSOLS BETWEEN 700 MILES AND 3000 MILES ABOVE SEA LEVEL PART 4: A STUDY OF THE EFFECTS OF ATMOSPHERIC FINE STRUCTURE CHARACTERISTICS ON THE VERTICAL DISTRIBUTION OF AEROSOLS Final Technical Report

Reinhold Reiter, Rudolf Sladkovic, and Walter Carnuth Jul. 1970 113 p refs
(Contract DAJA37-69-C-1357)
(AD-713024) Avail: NTIS CSCL 4/1

By means of sensors mounted on cable cars and a telemetry system, profiles are determined for temperature, humidity, wind, air conductivity and potential gradient, against pressure as a parameter of altitude. The site of the project is the Bavarian Alps in the vicinity of Garmisch Partenkirchen, at a uniquely instrumented range. Relationships are established between vertical aerosol distribution and meteorological parameters in the region of the upper boundary of the exchange layers. Electrical conductivity measurements were also made. The report will assist in studies of transport and diffusion of material in the atmosphere, weather modification, visibility, and radar signal propagation in mountainous terrain. Author (TAB)

N71-12818# Kaman Nuclear, Colorado Springs, Colo.

AN ANALYSIS OF WINDS TO 60 km OVER BATTERY MacKENZIE, C.Z. Final Report

C. Eugene Buell and Robert C. Bundgaard 6 Apr. 1970 185 p refs Sponsored in part by AEC Prepared in cooperation with Sandia Corp.
(KN-70-64-(FR); SC-CR-70-6101) Avail: NTIS

The wind component data from rawinsonde and rocketsonde observations were carefully inspected for errors and other irregularities. Reasonable adjustments were made or the data items were rejected. The resulting data file was fitted with a trigonometric polynomial that accounted for the quasi-biennial period, its first two harmonics, and the annual and semi-annual periods. The length of the quasi-biennial period was determined from ten years of wind records at Balboa, C.Z., since the length of record at Battery MacKenzie was too short. The residual winds were then used to compute covariance matrices with lags of 0, 1, 2, 4, 7, and 10 days. The covariance matrices for zero lag are subjected to a factor analysis and the residual variances and proper values and functions obtained. The residual variances clearly define the part of the wind component that cannot be described by reasonable analytical methods. Author

N71-12997# Air Weather Service, Scott AFB, Ill.
AIR WEATHER SERVICE WEATHER-MODIFICATION PROGRAM (FY 1970) Annual Survey Report
Herbert S. Appleman, Everett D. Figgins, and Laurence D. Mendenhall Aug. 1970 18 p
(AD-712392; AWS-TR-236; AR-3) Avail: NTIS CSCL 4/2

The report describes briefly the weather-modification (fog dissipation) projects undertaken by the Air Weather Service during FY 1970. The techniques employed, equipment used, and the project results are covered. This report is not intended to provide the technical details important to the weather-modification specialist but only to inform the AWS community of the current capabilities AWS possesses in weather modification. Author (TAB)

N71-13022# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ATMOSPHERIC HAZE: A REVIEW Final Report
O. A. Germogenova, J. P. Friend, and A. M. Sacco 31 Mar. 1970 184 p refs Prepared for Coordinating Res. Council, Inc., N.Y.
(Contracts PHS-CPA-22-69-29; PHS-CAPA-6-68(1-68))
(PB-192102; BBN-1821) Avail: NTIS CSCL 13B

Contents: General description of haze components; Mechanisms of haze formation; Distribution and dynamics of atmospheric aerosol; Quantitative analysis of turbulent diffusion; Optical properties of air pollutants; Instrumentation techniques for measuring hazes. USGRDR

N71-13040# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 239 28 Oct. 1970 p 8–31 (See N71-13038 03-34)
Avail: NTIS

Abstracts of articles are presented on an airborne spectrometer, anemometer for measuring atmospheric turbulence, autumn weather in the USSR, radiation balance of seas and oceans, cloud seeding with CO_2, solar radiation, and humidity and rainfall over the southeast Atlantic. F.O.S.

N71-13049# Naval Postgraduate School, Monterey, Calif.
NUMERICAL SIMULATION OF ATMOSPHERIC FLOW OVER AN IDEALIZED MOUNTAIN
James Keith De Boer (M.S. Thesis) Sep. 1970 45 p refs
(AD-712785) Avail: NTIS CSCL 4/2

The validity of linear smoothing of topography for numerical weather prediction and the variation of mountain drag with mountain height and static stability are examined in the study. In the model a constant geostrophic current is perpendicular to the mountain range and the height of the mountain is independent of y. The hydrostatic Boussinesq equations are used with motion bounded at the top by a rigid plane at $z = D$. A modified coordinate system similar to Phillips' sigma system was used. Solutions were obtained using a smoothed mountain profile. Comparison of these solutions shows that an error is introduced when non-linear terms become sufficiently large. Values of the mountain drag for differing values of mountain height at a given static stability and for differing values of static stability at a given mountain height were computed. Mountain drag was found to vary quadratically with mountain height and linearly with static stability. Author (TAB)

N71-13050# Air Force Global Weather Central, Offutt AFB, Nebraska.
AFGWC BOUNDARY LAYER MODEL
Kenneth D. Hadeen 1 Apr. 1970 63 p refs
(AD-713058; AFGWC-TM-70-5) Avail: NTIS CSCL 4/2

A limited area seven layer physical-numerical model for the lower tropospheric region is described. The grid interval is half that of the standard numerical weather prediction grid used in the hemispheric, free atmospheric operational model at the Air Force Global Weather Central (AFGWC). This model is an integral part of the complete AFGWC meso-scale (sub-synoptic) numerical analysis and prediction system. This model provides greater horizontal and vertical resolution in both the numerical analyses and numerical forecasts. It is used to predict the more detailed smaller scale atmospheric perturbations which are important in specifying sensible weather elements. Important features of this boundary layer model include: a completely automated objective numerical analysis of input data; the transport of heat and moisture by three dimensional wind flow (including terrain and frictionally induced vertical motions); latent heat exchange in water substance phase changes; and eddy flux of heat and water vapor. Author (TAB)

N71-13121# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MULTI-LEVEL NUMERICAL SCHEME FOR CALCULATING VERTICAL VELOCITIES IN THE TROPOSPHERE AND STRATOSPHERE
T. A. Galankhova 1 Jul. 1970 17 p refs Transl. into ENGLISH from Tr. Gidrometeorologicheskiy Nauchno-Issled. Tsentr SSSR (USSR), no. 27, 1968 p 25–34
(AD-712946; FTD-HT-23-311-70) Avail: NTIS CSCL 4/1

A multi-level numerical scheme, proposed for the calculation of vertical velocities, takes into account frontal terms and the actual stability distribution parameter given. The initial equations include equations for heat influx, eddy velocity, atmospheric statics, state and discontinuity. The solution is derived by simple iteration. Vertical velocities, calculated for each level by the Pyatygina method, are adopted as the first approximations. The method was checked using actual data fed into an electronic computer. The given magnitudes, obtained by the Pyatygina method at 192 grid intersections, and given magnitudes, calculated by the above scheme at 140 grid points on the 50-, 100-, 200-, 300-, 400-, 500-, 700-, and 850-mb surfaces, were fed from the computer. Comparison of the vertical velocities in frontal and anticyclonic areas, obtained by calculating temperature stratification curves, with velocities calculated by other methods, showed that temperatures at all levels could be most accurately calculated by the proposed numerical scheme and that errors in predicting temperatures in frontal areas could be effectively reduced by taking the frontal terms into account. Author (TAB)

N71-13166# Oklahoma Univ. Research Inst., Norman.
DEVELOPMENTS IN RADAR METEOROLOGY AND DATA PROCESSING Final Report
G. B. Walker and J. H. Horwedel Jul. 1970 46 p refs
(Grant ESSA-E-22-50-70(G))
(PB-193196) Avail: NTIS CSCL 04B

The report is essentially two reports in one. In the first report consideration is given to developing a Doppler radar system capable of resolving three-dimensional motion of precipitation, hence wind vectors, in severe storms; the second report is a review of mathematical technique applicable to computation of Doppler spectra from radar time domain data. Author (USGRDR)

N71-13174# Wisconsin Univ., Madison. Space Science and Engineering Center.
STUDIES IN ATMOSPHERIC ENERGETICS BASED ON AEROSPACE PROBINGS Annual Report, 1968
Verner E. Suomi Nov. 1969 162 p refs
(Grant ESSA-E-230-68(G))
(PB-192447) Avail: NTIS CSCL 04B

Contents: An objective technique of evaluating mesoscale convective heat transport in the tropics from geosynchronous satellite cloud photographs; A census of cloud systems over the tropical Pacific; A photographic summary of the earth's cloud cover for the year 1967; Meteorological applications of reflected radiance measurements from ATS-1 and ATS-3; Analysis of a stratospheric haze phenomenon photographed on the Gemini 5 spaceflight; Mechanisms of large-scale wave propagation through the tropics;

Three-dimensional, numerical solution of the atmospheric deep-convection problem; On the transient behavior of a simple model of convection; Measurements of solar radiation absorption in the tropical atmosphere; Prototype alignment jig for use in registering ATS pictures. USGRDR

N71-13222# Environmental Science Services Administration, Washington, D.C. Experimental Meteorology Lab.
CUMULUS CLOUD MODIFICATION: PROGRESS AND PROSPECTS
Joanne Simpson 1 Feb. 1970 43 p refs Presented at the Joint Symp. Commemorating the Golden Anniv. of the Am. Meteorol. Soc. and the Centennial of the U.S. Weather Serv., 12–14 Feb. 1970
Avail: Issuing Activity

Seeding experiments on supercooled cumuli, based on the dynamic approach, are discussed. In 1965 and 1968 randomized seeding experiments were conducted on single clouds in the Caribbean and South Florida, respectively. The 1965 experiment conclusively related seeding and cloud growth, both statistically and by means of a numerical model. The model predicts vertical growth of modified and unmodified clouds and distinguishes between conditions of good and poor seedability. The 1968 Florida program related cloud growth to rainfall, which showed about 100% increases for single clouds. Both the potential practical applications and possible impact upon large-scale meteorology of the dynamic seeding approach are discussed. Author

N71-13243# GCA Technology Div., GCA Corp., Bedford, Mass.
REDUCTION, ANALYSIS AND INTERPRETATION OF RADIATION BALANCE MEASUREMENTS FROM ESSA WEATHER SATELLITES Final Report
T. MacDonald and B. Loveless Apr. 1970 58 p refs
(Contract ESSA-E119-68(N))
(PB-192427; GCA-TR-69-17-G) Avail: NTIS CSCL 03B

The present report contains the results of a research study on the reduction, analysis, and interpretation of radiation balance measurements from ESSA weather satellites. Author (USGRDR)

N71-13247# Hydronautics, Inc., Laurel, Md.
NOTE ON THE CHOICE OF ANEMOMETER HEIGHT IN FROUDE SCALING OF WIND STRESSES
Jin Wu Jan. 1970 20 p refs
(Contracts Nonr-3688(00); N00014-70-C-0345)
(AD-712789; TR-231-28) Avail: NTIS CSCL 4/2

Extending previously proposed Froude scaling of wind-stress coefficients, the present note suggests the appropriate anemometer heights for different wind fetches, and proposes a procedure of obtaining the wind stress by a single wind velocity measurement at this suggested anemometer height. Author (TAB)

N71-13270# Istituto di Fisica dell'Atmosfera, Rome (Italy).
AIR POLLUTION: CONDENSATION NUCLEI MEASUREMENTS, ROME, SEPTEMBER–DECEMBER 1968 [INQUINAMENTO ATMOSFERICO: MISURE DI NUCLEI DI CONDENSAZIONE, ROMA, SETTEMBRE–DICEMBRE 1968]
M. Colacino, R. Franco, and F. M. Vivona May 1969 38 p In ITALIAN; ENGLISH summary
(IFA-TR-28) Avail: NTIS

The atmospheric pollution measurements made in Rome (Italy), September to December 1968, were well correlated with the condensation nuclei density and relative humidity. The mean nuclear radius calculations indicated their automobile engine origins. ESRO

N71-13336# Naval Postgraduate School, Monterey, Calif.
MEASUREMENT OF AIR TEMPERATURE AND WIND VELOCITY FROM ONE TO EIGHTY CENTIMETERS ABOVE THE SEA SURFACE
Gary Malcolm Davis (M.S. Thesis) Oct. 1969 110 p refs
(AD-706056) Avail: NTIS CSCL 4/2

A wave following mechanism was designed and tested at the field station operated by the Institute of Oceanography of the University of British Columbia. Separate measurements were made of temperature and velocity fluctuations by sensors attached to the vertically moving follower arm at heights of 1 cm, 5 cm, 24 cm, and 78 cm above the sea surface. These data were analyzed both by analog and digital methods. While the data generally follow the -5/3 power law proposed by Kolmogorov, there are significant departures from existing theories which could prove important. Since most air-sea interactions take place below 30 cm and few measurements have been made below this level, the wave follower could be a useful tool in investigating near surface phenomena. Author (TAB)

N71-13376# Melpar, Inc., Falls Church, Va. Meteorological Research Lab.
METEOROLOGICAL ANALOG TEST AND EVALUATION: FIRST FIELD TEST OPERATION Final Report
John K. Allison, Albert V. Duffield, and John M. Morton Jun. 1970 170 p refs
(Contract DA-42-007-AMC-339(Y))
(AD-713009; Rept-6224-F) Avail: NTIS CSCL 4/1

Above and within a deciduous hardwood forest near Cambridge, Md., 115 diffusion trials were conducted. A quasi-instantaneous point source of fluorescent particle (FP) tracer material was released and sampled by a 400-meter grid of Rotorods at a height of 2 meters. Vertical arrays of Rotorods were also utilized. Meteorological instruments and magnetic tape recorders were used to record data such as wind speed, direction, and elevation during the trials. Also included is a stand description made by standard forestry techniques and aerial photos of forest canopy. Diffusion parameters included cloud width, cloud thickness, direction and speed of movement. Canopy characteristics were also considered. A method of crossing statistics provided information on closure, geometric shape, and roughness of canopy. The differences between cloud parameters measured before and after leaf fall are discussed. The Richardson Number provided best indication of stability. The data analysis is presented in numerous tables. The data were summarized and reduced to provide quantified, descriptive terms of the diffusing cloud, the meteorological regime, and the forest physical characteristics for later comparison with similar trials to be conducted in different forests. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N71-12426# Advisory Group for Aerospace Research and Development, Paris (France).
AIRCRAFT LANDING SYSTEMS
Cornelius T. Leondes, ed. Sep. 1970 299 p refs Presented at Symp. of the Guidance and Control Panel of AGARD, Cambridge, Mass., 20–23 May 1969
(AGARD-CP-59-70) Avail: NTIS

Conference papers are presented on needs and requirements, system details, flight experience, and technical hardware of ILS and automatic landing systems for conventional and V/STOL aircraft. For individual titles, see N71-12427 through N71-12448.

N71-12427# Board of Trade, London (England).
ALL WEATHER LANDING
O. B. St. John *In* AGARD Aircraft Landing Systems Sep. 1970

6 p (See N71-12426 03-21)
Avail: NTIS

Problems encountered in low visibility landings by flight crews and with automatic landing systems are discussed. Several solutions are proposed and include: replacing the ILS system with a new system, supplementing ILS with an independent monitor, and using an inertial crutch. The reliability problems of automatic landings are also discussed. A landing measurement system was developed as an aid in solving the problems. E.H.W.

N71-12428# Pan American World Airways, Inc., Miami, Fla.
AN INTERNATIONAL AIRLINE VIEWS AUTOMATIC LANDING SYSTEMS
B. F. McLeod *In* AGARD Aircraft Landing Systems Sep. 1970 5 p (See N71-12426 03-21)
Avail: NTIS

The aim of all weather airline operations is to operate aircraft from originating gate to destination gate without outside reference. To achieve this aim, rules are set up for landing and take-off with some outside visual guidance for roll-out and taxiing to gates. A discussion is conducted for categories 1, 2, and 3 operations. Requirements for pilots and aircraft modifications are given. E.H.W.

N71-12429# Instrument Pilot Instructor School (ATC), Randolph AFB, Tex.
PSYCHOLOGICAL AND PROCEDURAL ASPECTS RELATED TO ILS APPROACHES AND LANDINGS IN VISIBILITIES LESS THAN 1200 FEET
Edwin W. Johnson, Donald L. Carmack, and Larry M. Hadley *In* AGARD Aircraft Landing Systems Sep. 1970 10 p (See N71-12426 03-21)
Avail: NTIS

The pilot control-display factors program was conducted to define the pilot's flight control-display requirements and to demonstrate solutions for flying on instruments from letdown through approach and landing. The procedural and psychological adjustments of pilots in different operational environments are discussed. E.H.W.

N71-12430# Litchford Systems, Northport, N.Y.
NEW DEVELOPMENTS IN LANDING SYSTEMS
G. Litchford *In* AGARD Aircraft Landing Systems Sep. 1970 5 p refs (See N71-12426 03-21)
Avail: NTIS

The system synthesis approach to developing new landing systems is described, emphasizing communication equipment. Both military and civil aviation are considered. Changes and requirements of a landing system to meet the needs of high performance of modern aircraft are proposed and include: (1) operational requirements, (2) flight dynamic requirements, (3) selection of radio frequency, (4) bandwidths, (5) data rates, and (6) modulation characteristics. E.H.W.

N71-12431*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
AUTOMATIC LANDING SYSTEM OPTIMIZATION USING INERTIAL NAVIGATION DATA AND MODERN CONTROL THEORY
Duncan MacKinnon *In* AGARD Aircraft Landing Systems Sep. 1970 18 p refs (See N71-12426 03-21)
(Contract NAS12-602)
(NASA-CR-111575) Avail: NTIS CSCL 17G

Conventional automatic landing systems utilize information provided by the Instrument Landing System (ILS) as the primary position reference during the acquisition and approach phases. The ILS position data is characterized by high noise level due to irregularities in the ILS signal structure as a result of reflections from objects on the ground illuminated by the ILS transmitter antennas. The high noise level filters required to reduce it to an acceptable level, stability and saturation constraints place significant limitations on the ability of the conventional landing system to resist the effects of environmental disturbances. Improved performance may be achieved by combining data from the ILS and an onboard inertial navigator. The resultant position, velocity, and lagged acceleration information is essentially free from noise. As a result a new control system configuration featuring improved accuracy and resistence to disturbances may be constructed and its performance compared to that of a conventional system. Author

N71-12432# Sperry Rand Corp., Phoenix, Ariz. Flight Systems Div.
IMPORTANCE OF SPEED CONTROL RELATIVE TO LONGITUDINAL TOUCHDOWN DISPERSION
R. G. Loome *In* AGARD Aircraft Landing Systems Sep. 1970 12 p (See N71-12426 03-21)
Avail: NTIS

The effects of radio altimeter errors, aircraft position errors, and wind on the flare initiation point, rate of descent at touchdown and longitudinal dispersion using a fixed parameter, and exponential flare trajectory are illustrated. These same effects are illustrated simultaneously with changes in reference airspeed and changes in glide slope beam angles. The effect of changing parameters of the flare control law is discussed. The data presented demonstrate that the effect of reference airspeed changes on touchdown and flare initiation altitude dispersions can be reduced by varying the touchdown rate-of-descent parameter in the flare control law as a function of reference airspeed. It is further demonstrated that variation of the flare control law as a function of reference air speed and flight path angle (with respect to the air mass) can eliminate dispersion resulting from reference airspeed and glide slope beam angle changes, and minimize dispersion resulting from wind conditions. The use of reference airspeed and flight path angle parameter control would depend upon rigid speed and path control while tracking the glide slope beam and minimum interaction between the speed and path control subsystems. This can best be accomplished with the consistency of automatic systems. Author

N71-12433# Federal Aviation Administration, Washington, D.C.
NEW GUIDANCE DEVELOPMENTS FOR ALL WEATHER LANDING
David J. Sheftal *In* AGARD Aircraft Landing Systems Sep. 1970 9 p (See N71-12426 03-21)
Avail: NTIS

Feasibility developments to satisfy current and anticipated needs of civil and military airports are discussed. These developments include fixes for current landing systems as well as totally new techniques to replace and/or supplement current equipment. To fully evaluate what alternatives are most responsive to need, there is a joint concerted effort by civil government, military, and aircraft operator groups to define operational requirements and to determine what maximum degree of commonality can be achieved toward a standard modular system for common use. Author

N71-12434# Smiths Industries, Ltd., Cheltenham (England). Aviation Div.
DEVELOPMENT OF AIRBORNE HARDWARE FOR AUTOMATIC LANDING SYSTEMS
R. I. Bishop *In* AGARD Aircraft Landing Systems Sep. 1970 13 p refs (See N71-12426 03-21)
Avail: NTIS

The design, manufacture, and tests of an autopilot system are discussed. Redundancy forms for fail-operational and fail-soft capabilities of the system, and modifications to improve autopilot performance are described. E.H.W.

N71-12435# Airborne Instruments Lab., Deer Park, N.Y.
POST-1970 SCANNING BEAM APPROACH AND LANDING
Joseph E. Woodward *In* AGARD Aircraft Landing Systems Sep. 1970 13 p refs (See N71-12426)
Avail: NTIS

A brief review covering the system design and flight test programs of the scanning beam is given. The FAA system is used to illustrate the basic concepts and their application to a full scale system. The systems developed for different applications are described, and flight test results are given. Author

N71-12436# Royal Aircraft Establishment, Farnborough (England).
LANDING VTOL AIRCRAFT IN ADVERSE CONDITIONS AND SOME POSSIBLE SOLUTIONS
D. J. Walters *In* AGARD Aircraft Landing Systems Sep. 1970 10 p (See N71-12426 03-21)
Avail: NTIS

Flight trials were carried out on an unstabilized P-1127 vectored thrust aircraft flown into a restricted site by night to give first hand experience to the pilot under adverse conditions. It was determined that the pilot needs a fairly accurate knowledge of position relative to landing site to get the best operational advantage. The tracking method proposed for obtaining angular information is based on the interferometer principle and a solid state microwave power source. The flight maneuvers, and the airborne and ground equipment are discussed. N.E.N.

N71-12437# Centre d Essais en Vol, Bretigny-Sur-Orge (France).
EXPERIENCE OF THE FRENCH FLIGHT TEST CENTER IN THE AREA OF ALL WEATHER LANDING [EXPERIENCE DU CENTRE D'ESSAIS EN VOL FRANCAIS DANS LE DOMAINE DE L'ATTERRISSAGE TOUT TEMPS]
Y. Michot *In* AGARD Aircraft Landing Systems Sep. 1970 4 p In FRENCH (See N71-12426 03-21)
Avail: NTIS

Results of flight tests of the all-weather landing system are presented. Tests were made on the M.S. 760, Nord 262, and Caravelle aircraft. The results verify the importance of certain altitudes: 100 feet, 50 feet, 15 feet, and touchdown. It was found that it is not necessary to double systematically the automatic pilots to have a safe approach and landing in Category 3A conditions. It is also felt that the safety is always guaranteed by the capability of the pilot to take over control manually. Transl. by E.H.W.

N71-12438# Naval Material Command, Washington, D.C.
AUTOMATIC LANDING SYSTEMS ARE HERE
John L. Loeb *In* AGARD Aircraft Landing Systems Sep. 1970 19 p (See N71-12426 03-21)
Avail: NTIS

An automatic landing system was developed for operational use on aircraft carriers and for training ashore. The system enhances all-weather capability and increases flight safety. The system development, problems and solutions, fail-safe and safety features, and hardware and software interfaces are discussed. Author

N71-12439*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
AIDED INERTIAL FLIGHT TEST EXPERIMENTS
Ronald J. Madigan and Edmund J. Koenke *In* AGARD Aircraft Landing Systems Sep. 1970 16 p (See N71-12426 03-21)
(NASA-TM-X-66490) Avail: NTIS CSCL 17G

The flight program is described which is designed to test navigation, guidance and control system concepts, requirements, flight hardware and software which can make all weather V/STOL operations technically feasible. The availability of the Gemini space vehicle guidance and communication systems along with the supporting ground systems equipment allowed the opportunity to test, with hardware, those guidance and control concepts which had been studied in relationship to aided inertial systems for aircraft applications. The flight testing was contrived to establish navigation and guidance system performance using radar position data for up-dating in the on-board computer. It is concluded that an improved total navigation capability can be achieved with available technology and that with equipment which is ten years old it is possible to predict the aircraft touchdown point to within a ten foot cross section on the runway. Author

N71-12440# Smiths Industries, Ltd., Cheltenham (England). Aviation Div.
THE DEVELOPMENT OF AUTOMATIC LANDING FOR BEA OPERATION
J. L. Weston *In* AGARD Aircraft Landing Systems Sep. 1970 22 p re s (See 71-12426 03-21)
Avail: NTIS

The in-flight experience of the autopilot system is discussed, and the important stages of the flight trials through to certification demonstrations are traced. Experiences in operating the system installed in commercial planes are also examined. Some of the problems revealed by the trials are exagnined in detail. Controlling interference on the ILS radio beams is considered to be the major problem requiring solution. A continuing program of pilot training is maintained. Author

N71-12441# Elliott Bros., Ltd., London (England). Transport Aircraft Controls Div.
EXPERIENCE GAINED BY BAC AND ELLIOTT IN THE DEVELOPMENT AND SERVICE USE OF AUTOMATIC LANDING SYSTEMS
M. F. Moulton *In* AGARD Aircraft Landing Systems Sep. 1970 19 p (See N71-12426 03-21)
Avail: NTIS

The development of the VC-10 autopilot landing system is discussed. The basic fail-operative configuration, basic integrity and development of in-line monitoring, improved self-monitoring techniques, and pilot displays are described. The flight test program and the problems areas are also considered. It is felt that it is necessary to carry out quite elaborate on-aircraft testing using aerodynamic simulators and dynamic response test equipment to ensure a repeatable standard of performance during flight test. N.E.N.

N71-12442# Lockheed-Georgia Co., Marietta.
THE AUTOPILOT FOR THE C-141 ALL WEATHER LANDING SYSTEM
Thomas L. Cronley and Robert E. Glacken (Bendix Corp., Teterboro, N.J.) *In* AGARD Aircraft Landing Systems Sep. 1970 20 p (See N71-12426 03-21)
Avail: NTIS

The basic configuration and operation of the autopilot are discussed. The Autoland system provides tight tracking of the localizer and glide slope beams, wind-shear capability, flare computt computation, and beam gain desensitizing as a function of radar altitude. Redundancy and monitoring, together with a means of testing the approach functions en route, are incorporated in the system. The system condition for a monitored Category 2 approach is determined by the preland test and en route test. Problem areas identified during the flight test program, and resulting modifications to the system are also described. N.E.N.

N71-12443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
DIRECT LIFT CONTROL FOR APPROACH AND LANDING
Robert C. Lorenzetti *In* AGARD Aircraft Landing Systems Sep. 1970 17 p refs (See N71-12426 03-21)
Avail: NTIS

Direct lift control (DLC) is a system which produces lift forces in the direction the pilot desires to move the airplane

without significant pitching moment. The DLC enhances precision longitudinal maneuvering capability by providing a change in altitude or rate of climb without a change in pitch attitude and without the initial acceleration reversal, delay in lift build-up, and excessive pitch rate overshoot associated with conventional elevator control. This is accomplished by moving an auxiliary lift surface(s) such as biased spoilers, symmetrically operated ailerons, flaps, or canards in addition to the elevator. The DLC systems can be either blended (responding to normal longitudinal stick movements) or separate (activated by a thumb-wheel or other auxiliary lever). They can be open loop (with fixed ratio interconnect between the elevator and DLC surface) or closed loop (with feedbacks of pitch angle, pitch rate, pitch acceleration, and/or normal acceleration). In general, blended closed loop systems give the best performance but are the most expensive. Additional DLC benefits include reduction in normal acceleration of the aircraft center of gravity, improved handling in turbulence, and reduction in pilot workload. Author

N71-12444# Societe Francaise d Equipments pour la Navigation Aerienne, Neuilly-Sur-Seine (France).

THE AUTOMATIC PILOT, TAPIR [LE PILOTE AUTOMATIQUE, TAPIR]

M. Pagnard *In* AGARD Aircraft Landing Systems Sep. 1970 8 p In FRENCH (See N71-12426 03-21)

Avail: NTIS

The developmental problems of the automatic pilot TAPIR, are discussed. The pilot, built for category 1 type aircraft, can, with simple material extensions, be utilized for category 2 and 3 type aircraft. The performance capabilities of the automatic pilot are given. Transl. by E.H.W.

N71-12445# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

FLIGHT CONTROL SYSTEMS WITH RESPECT TO V/STOL AUTOMATIC LANDING

H. G. Schumann and R. Staufenbiel *In* AGARD Aircraft Landing Systems Sep. 1970 19 p (See N71-12426 03-21)

Avail: NTIS

Preliminary investigations were carried out for establishing the specification of ground and airborne equipment for instrument and automatic VTOL landings. The problems of optimizing landing profiles, pilot handling, and display systems are discussed, as well as the influences of flight control and automatic flight control systems. The development status of hardware for in-flight simulations of instrument and automatic landings with the hovering test rig are described. Author

N71-12446# Advisory Group for Aerospace Research and Development, Paris (France).

THE LANDING SYSTEM OF THE THOMSON/CSF: LS 371, SATRAM, SYDAC/ILS [SYSTEMES D'ATTERRISSAGE DE THOMSON/CSF: LS 371, SATRAM, SYDAC/ILS]

P. Dautrement *In its* Aircraft Landing Systems Sep. 1970 15 p In FRENCH (See N71-12426 03-21)

Avail: NTIS

The equipment and operation problems of the automatic landing systems—LS371, STRAM, and SYDAC/ILS—of the Thomson/CSF are discussed. Performance, applications, and limitations of the system are given. The systems are used for all-weather landing in civil and military aviation. Transl. E.H.W.

N71-12447# Royal Aircraft Establishment, Farnborough (England).

EVOLUTIONARY EXTENSION OF ILS

J. Benjamin *In* AGARD Aircraft Landing Systems Sep. 1970 17 p refs (See N71-12426 03-21)

Avail: NTIS

Recent VHF ILS research and development and projected future evolution are outlined. The research and development activities include instrumental accuracy, test gear for in-line servicing, operational integrity, weather effects, reliability, airborne antennas, beam calibration, and monitoring. The problem of higher integrity was pursued by four approaches: ground based monitoring and equipment, application of the independent sideband detection technique of the airborne receiver, raising the localizer integrity by special designing, and microwave correlation protected ILS. Hyperbolic correlation is discussed with respect to three areas of future application: integrity of a microwave correlation system providing time and velocity discrimination, low cost ILS with high accuracy and reliability, and terminal area traffic handling. N.E.N.

N71-12448# Sud-Aviation, Blagnac (France).

THE AUTOMATIC LANDING SYSTEM OF THE CONCORDE [LE SYSTEME D'ATTERRISSAGE AUTOMAIQUE DE CONCORDE]

R. Deque *In* AGARD Aircraft Landing Systems Sep. 1970 18 p In FRENCH (See N71-12426 03-21)

Avail: NTIS

After reviewing objectives for the supersonic transport Concorde, the means by which the automatic and general landing systems function in low visibility are examined. Transl. by E.H.W.

N71-12573*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.

ATTITUDE CONTROL AND STRUCTURAL RESPONSE INTERACTION

Jacob Abel 15 Nov. 1970 16 p

(Contract NAS7-100)

(NASA-CR-111563; JPL-TR-32-1461) Avail: NTIS CSCL 17G

An assessment of the problem of the interaction between the structural or elastic response of a spacecraft and the attitude control system dynamics is presented. A general discussion of the possible modes of interaction provides a means of classifying a given spacecraft with respect to the interaction problem. A model spacecraft system is studied and some parameters characterizing the interactions are identified. The question of system stability in the mathematical sense is discussed and the idea of a definition of a practical stability criterion is presented. This concept is applied to the model spacecraft system. Some comments on the adequacy of present methods of evaluating the significance of interactions between attitude control systems and structures are given with particular regard to the concept of frequency separation. Author

N71-12584# Eurocontrol Agency, Brussels (Belgium).

OPERATIONAL, TECHNICAL AND ECONOMIC ASPECTS OF AN AERONAUTICAL SATELLITE SYSTEM FOR CIVIL AIR TRAFFIC CONTROL [BETRIEBLICHE, TECHNISCHE UND WIRTSCHAFTLICHE ASPEKTE EINES AERONAUTISCHEN SATELLITENSYSTEMS FUER DIE ZIVILE FLUGSICHERUNG]

R. H. G. Martin and O. L. Geigner Duesseldorf Deut. Ges. fuer Ortung und Navigation 1969 45 p In GERMAN Presented at the Intern. Navigation Meeting, Hamburg, 28 - 30 Oct. 1969

Avail: NTIS

The economic and operational problems connected with the introduction of a navigation satellite system are discussed. The questions arising in air traffic control and flight path assignment over the North Atlantic are discussed. It is concluded that subsonic traffic, using inertial navigation, will not necessitate the installation of navigational satellite systems. This will, however, become necessary for supersonic air transport to improve ground-air communications. ESRO

N71-12601# Advisory Group for Aerospace Research and Development, Paris (France).

THE APPLICATION OF DIGITAL COMPUTERS TO GUIDANCE AND CONTROL

G. Alan Whitfield, ed. Nov. 1970 277 p refs Presented at

10th Meeting of the Guidance and Control Panel of AGARD, London, 2—4 Jun. 1970
(AGARD-CP-68-70) Avail: NTIS

The use of integrated circuits and medium size integrated devices in designing digital computers for aerospace vehicles is considered. The manner in which digital computers are being or can be used to improve the navigation and control of aerospace vehicles and the design of the computers themselves are emphasized. For individual titles, see N71-12602 through N71-12624.

N71-12603# Ferranti, Ltd., Manchester (England).
TRENDS IN THE APPLICATION OF DIGITAL COMPUTERS TO GUIDANCE AND CONTROL
W. H. McKinley, M. A. V. Matthews, and R. Wright *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 8 p ref (See N71-12601 03-21)
Avail: NTIS

A historical review of the growth of the total guidance and control system requirement, primarily in manned aircraft, is presented. Flight control, the significance of displays as a man-machine interface, and the growth of navigation from a human operated task to one demanding processing and automatic computation are considered. After a brief discussion of the specific aspects of these requirements which indicate advantages in mechanising them using airborne digital computers, the effect of progressing from analog to digital techniques is examined. Some of the system options available in designing a digital system for an aircraft are summarized and machines which have been used in experimental work or as the basis for studies are described. The problems of input and output control are discussed and the Ferranti S interface developed for use with the FM 1200 computer is described. Reference is made to the use of sensor processing techniques as opposed to central computing. Author

N71-12604# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
SYSTEMS TASKS FOR THE DATA PROCESSING EQUIPMENT OF ADVANCED AIRCRAFT NAVIGATION SYSTEMS
F. G. Unger and R. S. Sindlinger *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 15 p (See N71-12601 03-21)
Avail: NTIS

The tasks of the data processing equipment in advanced navigation systems for aircraft are vastly increased as compared to conventional systems in use today. Major tasks are processing of different sensor information, solution of navigation equations, optimal use of redundant data by filtering and estimation, automatic mode control, and malfunction detection and isolation. These tasks are described in detail and possible hardware solutions are discussed. Author

N71-12608# Elliott Flight Automation, Ltd., Rochester (England). Airport Works.
THE CASE FOR SPECIALISED SYSTEM PROCESSORS IN AIRBORNE INSTALLATIONS
P. A. Hearne *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 15 p (See N71-12601 03-21)
Avail: NTIS

The favourable changes made possible in avionic systems by the ready availability of low-cost, single or limited task processors are examined. The system requirements of airborne data processors in the areas of navigation, weapon delivery, flight control, engine control, air data and displays are also considered. From this examination, three different generic types of processor are derived. One of these generic types, a small control processor, is examined in detail and the various analyses and tradeoff studies carried out to determine its structure are summarized. The hardware implementation of this machine is then discussed. Finally, a comparison between a 'distributed computer' avionics system using a number of these machines on a large, centralized multiprocessor system is made. From this comparison, it is shown that the distributed system has a number of important advantages and is a more flexible and cost-effective solution for avionics systems. Author

N71-12610*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT RESEARCH EXPERIENCE WITH GUIDANCE AND CONTROL COMPUTERS RELATED TO GENERAL APPLICATIONS
Melvin E. Burke *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 12 p refs (See N71-12601 03-21)
(NASA-TM-X-66491) Avail: NTIS CSCL 17G

Several guidance and control research programs involving the X-15 and F-104 airplanes are discussed, with the discussion oriented toward airborne digital computer utilization. An analog and a digital systems mechanization are compared, and the performance advantages of the digital system are pointed out. The flexibility of the digital computer as a research tool is indicated, as are advantages of decentralized computers. Application of a general purpose computer to the solution of strapdown system equations was successful in the laboratory in preparation for a flight program. The effects of input-output mechanizations on software complexity are discussed. The utility of a general purpose digital computer is shown by its flexibility in being used for various research tasks. This utility is degraded, however, by the effort required to write programs in machine language for real-time applications. Author

N71-12611# Royal Aircraft Establishment, Farnborough (England). Avionics Dept.
DIGITAL COMPUTING ASPECTS OF THE JAGUAR NAV/ATTACK SYSTEM
D. E. Humphries *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 10 p ref (See N71-12601 03-21)
Copyright. Avail: NTIS

The Jaguar navigation/attack system performs approximately the same task as that in the Harrier aircraft, which is wholly analog, but does the job using a digital computer for roughly the same cost. Despite the similarity of Harrier system requirements, every endeavour has been made to prevent the system from becoming a digital copy of analog ideas, but to approach each requirement from a digital viewpoint. The lessons that have been learned and the techniques that have been evolved during its development up to its present stage of aircraft flight trials are described. A brief description of the units which comprise the system and the facilities which it provides is given, with particular emphasis on those areas where the change to a digital computer has allowed much greater design freedom and operational flexibility. Author

N71-12612# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
THE EFFECT OF DIGITAL COMPUTER LIMITATIONS AND SENSOR ERRORS ON THE ACCURACY OF AN AUTOMATIC BOMB RELEASE
Gerhard Schroeter *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 7 p (See N71-12601 03-21)
Avail: NTIS

Onboard computer and attitude/air data sensor errors cause delivery errors of automatically released bombs. For a retarded bomb, it is shown by numerical evaluation that with a uniform distribution of release conditions the computing error is approximately normally distributed with mean value zero and standard deviation sigma, sigma being dependent on the degree of the polynomial and the width of the admissible interval of release conditions. Formulas

are also derived for estimating the influence of the inaccuracy of weapon computer input data on the impact point. These formulas can be applied to derive the requirements which attitude/air data sensors should satisfy to provide for sufficiently accurate bombing. An example is given. Author

N71-12614# Smiths Industries, Ltd., Cheltenham (England). Aviation Div.

HIGH INTEGRITY DIGITAL FLIGHT CONTROL

J. F. Meredith and K. A. Helps *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 7 p (See N71-12601 03-21)

Avail: NTIS

The development of high integrity digital flight control is discussed with respect to the variation in performance of nominally identical pieces of equipment. In a multiplex system each analog subchannel has a certain design transfer function which is approximately achieved in practice by the use of one or more amplifiers of finite gain together with various smoothing and stabilizing filters. Discrepancies between subchannels arise because of the legitimate variation of component values within their tolerance band. The discrepancies in transfer function may affect the signals which are being processed in a way which is indistinguishable from certain fault conditions. As a result, the level of the threshold of signal discrepancy above which the system detects a fault must be made higher than the level which may legitimately be caused by component value variations. The use of high integrity digital flight control is considered as a way to overcome such problems. Author

N71-12616# Elliott Flight Automation, Ltd., Rochester (England). Airport Works.

DIGITAL DATA PROCESSING IN AUTOMATIC FLIGHT CONTROL SYSTEMS

R. W. Howard *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 15 p (See N71-12601 03-21)

Avail: NTIS

Digital data processing is examined as another technique for the designer of automatic flight control systems. It is discussed in relation to three general aspects of all AFCS, those of inner loop, outer loop and executive functions. Various types of modern aircraft system are compared in assessing the impact of digital techniques and it is concluded that although it is not cost effective for all computing requirements at present, it will progressively replace analog flight control computing in the future. A warning is given against adopting central computing techniques as a means of speeding this process. Author

N71-12617# Royal Aircraft Establishment, Farnborough (England). Space Dept.

THE USE OF A DIGITAL COMPUTER FOR THE ELDO INERTIAL GUIDANCE SYSTEM

M. J. W. Gage *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 10 p refs (See N71-12601 03-21)

Avail: NTIS

The projected ELDO inertial guidance system employs a small digital computer. Those systems of a typical satellite launch vehicle that are suitable for mechanisation on such an onboard digital computer are listed, and details are given for the case of the ELDO vehicle. The reasons for the choice of the computer and its role in the system are explained together with some details of the formulation and programming of the guidance law subsystem. Author

N71-12622# Central Inertial Guidance Test Facility, Holloman AFB, N.Mex.

THE TESTING OF COMPUTER-EQUIPPED GUIDANCE AND NAVIGATION SYSTEMS

Martin G. Jaenke *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 14 p refs (See N71-12601 03-21)

Avail: NTIS

The use of computers in aided navigation systems to make optimum estimates of the system's state or to perform the coordinate transformation function in strapdown systems involves the evaluation of complex computer software in the test process, using two approaches. In the first, the evaluation is based on the analysis of the recorded test outputs of the systems computer. In the second, recorded or reconstructed subsystem test outputs are fed into a ground-based computer and used to re-run the test as frequently as desired with a variety of computer algorithms. In this way, optimization of the algorithm under actual test conditions can be achieved efficiently. Examples are given for both approaches and the digital test data collection process is described. Author

N71-12623# Bendix Corp., Teterboro, N.J. Navigation and Control Div.

FAULT ISOLATION IN A DIGITAL GUIDANCE AND CONTROL COMPUTER

David H. Blauvelt *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 7 p (See N71-12601 03-21)

Avail: NTIS

The capabilities of a general purpose digital computer used in a guidance and control application can be used to realize an optimum fault isolation capability for the system. If proper attention is given to the functional partitioning of the computer, self-test and self-diagnostic programs can be written to determine that faults have occurred and isolate them to the replaceable card level. This can be accomplished with virtually no additional flight hardware and a relatively simple test console which allows maintenance personnel to communicate with the computer in question. Author

N71-12756# European Space Research Organization, Paris (France). Directorate of Programmes and Planning.

AERONAUTICAL SATELLITES

D. Lennertz Jun. 1970 23 p refs

(ESRO-SP-61) Avail: NTIS

After a brief description of the historical background of aeronautical satellites, the present and future nonsatellite means of air traffic control and their limitations are discussed. The services, the economic and technical aspects of an aeronautical satellite system are considered, resulting in the call for carrying out the envisaged ESRO/NASA aeronautical satellite program, which is also briefly described. Author (ESRO)

N71-13058*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SYSTEM DESIGN OF A UNIQUE MAGNETIC ATTITUDE AND SPIN CONTROL SUBSYSTEM

Robert W. Fulcher Washington Dec. 1970 23 p

(NASA-TN-D-6051; G-992) Avail: NTIS CSCL 17G

A preferred system for spacecraft spin axis orientation and spin rate control utilizing earth's field magnetic torquing is selected by comparison of alternative spin mode mechanizations. The unique capability of the selected system is its ability to meet unusually stringent weight and power requirements. The Small Scientific Satellite control requirement, used as a baseline for presenting the magnetic system in this report, was met by a subsystem weighing only 2.5 lb and requiring only 3.2 W when energized. An additional feature of the magnetic system presented is its compatibility with automatic turn-on for missions involving elliptical orbits. The system was thoroughly tested in controlled magnetic fields on a torque measuring instrument. Author

N71-13063*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.

A FREQUENCY DOMAIN SOLUTION FOR THE LINEAR

ATTITUDE-CONTROL PROBLEM OF SPACECRAFT WITH FLEXIBLE APPENDAGES

M. R. Trubert 15 Nov. 1970 38 p refs
(Contract NAS7-100)
(NASA-CR-111558; JPL-TR-32-1478) Avail: NTIS CSCL 17G

The three dimensional linear interaction problem between attitude control of spacecraft and the flexibility of spacecraft is solved in the frequency domain by using the concept of Fourier transform. The transfer function matrix of the system formed by the linear structure and the linear control circuit is determined from the modal characteristics of the structure, using the modal combination concept and the electrical characteristics of the control loop. A large number of elastic modes can be used for the structure. Time histories are obtained by inverse Fourier transformation. The three angles of the attitude of the spacecraft with respect to an inertial frame of reference are computed for any disturbance torques applied about the three axes of the spacecraft. A stability study is made by direct inspection of the responses to unit impulse for the three attitude angles or, alternatively, by the display of a determinant. A computer program has been written to compute all of the necessary transfer functions, and the fast Fourier transform algorithm has been used to compute Fourier transforms. The program is used on a teletype terminal. Author

N71-13179 Lockheed Missiles and Space Co., Palo Alto, Calif.
SOME QUESTIONS ON THE ACCURACY OF THE ION METHOD OF ORIENTATION

I. G. Ioffe et al [1970] 5 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 8, no. 4, 1970 p 629-632
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The operation of ion orientation sensors is based on preception of an oncoming stream of charged particles in the upper layers of the earth's atmosphere and determination of the deviation of one of the vehicle axes from the stream direction. The construction of one kind of ion instrument and equations for its operation in the particular case of coincidence between the vehicle axes and the axes of the orbital coordinate system are presented. It is assumed that the functional diagram of the system consists of two independent channels of pitch and yaw. The methodological errors which appear when the vehicle axes do not coincide with the orbital axes are investigaged. Author

N71-13194# Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
COMPARATIVE STUDY OF PROPOSED SIGNAL ACQUISITION METHODS FOR PLAT CROSSHAIR STABILIZATION

David R. Flanders 15 Sep. 1970 103 p
(AD-712511; NAEC-ENG-7669) Avail: NTIS CSCL 17/7

The report presents a comparative study of two proposed stabilization systems in an attempt to determine the most reliable interim measure providing a stabilization signal to the PLAT (Pilot - L.S.O. Landing Aid Television) mirror. In addition, a brief summary of the work presently accomplished in the area of PLAT stabilization is undertaken. Author (TAB)

N71-13200*# Sperry Phoenix Co., Ariz. Flight Systems Div.
A CONTROL MOMENT GYRO FINE ATTITUDE CONTROL SYSTEM Final Technical Report

R. Van Riper Aug. 1970 266 p refs
(Contract NAS9-10363)
(NASA-CR-108702) Avail: NTIS CSCL 17G

After considering the design mission requirements, deriving the vehicle disturbance torques, and performing a system comparison study, the 4-FACS CMG configuration was chosen as the preferred fine attitude control system. This configuration was selected since it has the best combination of low system weight and power, good accuracy capability, and high reliability. The other systems considered were a reaction wheel system, scissored-pair CMG system, and a reaction control jet system. The 4-FACS was synthesized, CMG's sized to meet the performance requirements, and an analog computer simulation was conducted to evaluate system performance. Three axis simulations were run to investigate the following: constant gain steering law; pseudo-torque feedback steering law; one-gyro failed operation; momentum desaturation techniques; scissored pair CMG configuration with one gyro failed; and low torque system (unmanned). The simulation results indicated that the 4-FACS CMG configuration will give acceptable performance with some cross-coupling when operating with a simplified constant gain steering law; however, a pseudo-torque feedback steering law provides better performance and was chosen as the preferred law. Author

N71-13201 Advisory Group for Aerospace Research and Development, Paris (France).
INERTIAL COMPONENT TESTING: PHILOSOPHY AND METHODS

W. G. Denhard, ed. Jul. 1970 596 p Presented at AGARD Guidance and Control Panel, Paris, Jun. 1968
(AGARDograph-128) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

CONTENTS:

1. INTRODUCTION: THE TESTING OF SENSORS FOR INERTIAL QUANTITIES C. S. Draper (MIT, Cambridge) p 11-15 (See N71-13202 03-21)

2. THE EVOLUTION OF TESTING OF PRECISION GYROS AND ACCELERATORS W. G. Denhard (MIT, Cambridge) p 17-42 refs (See N71-13203 03-21)

3. THE ECONOMIC JUSTIFICATION FOR GYRO TESTING W. G. Denhard (MIT, Cambridge) p 43-55 refs (See N71-13204 03-21)

4. GYRO TEST INSTRUMENTATION D. F. Keaney and R. L. King (MIT, Cambridge) p 57-178 refs (See N71-13205 03-21)

5. PRECISION INERTIAL GYRO TESTING AT MIT P. J. Palmer, W. A. Gianoukos, W. C. Donovan, F. E. Cartwood, A. J. Smith et al (MIT, Cambridge) p 179-282 refs (See N71-13206 03-21)

6. TESTING THE PRECISION ACCELEROMETER M. S. Sapuppo, P. J. Pijoan, and J. H. Buchanan (MIT, Cambridge) p 283-365 refs (See N71-13207 03-21)

7. TESTING AND ACCEPTANCE OF INSTRUMENTS AT A SYSTEM LEVEL K. Fertig (MIT, Cambridge) p 367-407 refs (See N71-13208 03-21)

8. GYRO TESTING TECHNIQUES IN THE UK J. V. Carter (RAE, Farnborough) p 409-451 refs (See N71-13209 03-21)

9. DIAGNOSTIC TESTING AND DESIGN SHORTCOMINGS IN PRECISION GYROSCOPES O. H. Wyatt (RAE, Farnborough) p 453-463 refs (See N71-13210 03-21)

10. SCALE FACTOR MEASUREMENT OF MOTORS D. Berard (Centre d'Essais en Vol, Bretigny-Sur-Orge) p 465-484 (See N71-13211 03-21)

11. A 10g TABLE AND THE REQUIREMENTS OF GYROSCOPIC MATERIALS UNDER ACCELERATION E. Olivier (Lab. de Recherches Balistiques et Aerodynamiques, Vernon, France) p 485-523 refs (See N71-13212 03-21)

12. STUDY OF LINEAR MOTION OF ACCELEROMETERS ON CENTRIFUGE C. Mauffret (Lab. de Recherches Balistiques et Aerodynamiques, Vernon, France) p 525-545 refs (See N71-13213 03-21)

13. TESTING OF GYROS AND ACCELEROMETERS WITH HYDROSTATIC GAS BEARINGS W. Auer, W. Fehse, and A. Wand (Teldix Luftfahrt-Austruestungs G.m.b.H.) p 547-580 refs (See N71-13214 03-21)

N71-13202# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

INTRODUCTION: THE TESTING OF SENSORS FOR INERTIAL QUANTITIES

C. S. Draper *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 1–15 (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks,Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Indicators based on gyroscopic elements adapted to the purpose of providing reference coordinates for the control of orientation in aircraft, marine vessels, and space vehicles work in combination with devices sensing specific forces to produce signals for realizing self-contained geometrical references. Basic functions sensed are angular deviations from instrumentally adjustable reference orientations and specific forces with signal generation that represent this input. Testing methods are directed to determine sensor capabilities for receiving angular deviation and specific force with output signals corresponding to prevalent environmental conditions. Considered categories are: (1) research tests; (2) engineering subsystem tests; (3) engineering tests; (4) calibration type tests; (5) screening tests; (6) calibration tests; and (7) inspection tests. G.G.

N71-13203# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

THE EVOLUTION OF TESTING OF PRECISION GYROS AND ACCELEROMETERS

W. G. Denhard *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 17–42 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

This is a brief review of precision gyro and accelerometer testing over the past twenty years. An attempt is made to trace the transition of gyro testing techniques from fire control to navigation and guidance purposes. Evolution of gyro and accelerometer testing has been tied in with the improvement of instrument performance desired and with the stability (electrical and mechanical) of the available test equipment. The evolution of techniques for testing has overall led to better performance and more reliable instruments. Author

N71-13204# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

THE ECONOMIC JUSTIFICATION FOR GYRO TESTING

W. G. Denhard *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 43–55 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn: Mr. A. L. Candido)

The determination of the reliable performance life of gyroscopes through a testing program adequate in duration and content is discussed. The development of this topic leads to a comparison of overall costs of purchase and use versus reliable performance life. It is shown that increased testing, although raising purchase price, can result in a lower cost per use hour via a longer reliable performance life by rejecting deficient gyros. Two possible series of tests for limited times of approximately 50 and 100 hours are presented as are recommendations for sampling tests of longer duration for a higher assurance level of test validity. Author

N71-13206# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

GYRO TEST INSTRUMENTATION

D. F. Keaney and R. L. King *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 57–178 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

As gyro performance has improved over the years, interfering inputs once considered negligible have become significant. This is illustrated by tracing the evolution of gyro testing stations. Current philosophy in the areas of environment control such as base-motion isolation and temperature control, environment simulators such as vibrators and centrifuges, and minimization of error sources both electrical and mechanical is described in considerable detail. Examples of existing one-g and linear vibration high-g test stations follow to show the application of this philosophy to practice. Certain aspects of the test station are focused upon to illustrate the trade-offs necessary to arrive at a technically sound, economically justifiable test station. Test stations for tomorrow's gyros may be of the conventional type using either a single-axis or a two-axis test table on a carefully chosen and prepared site. Alternatively, it may be necessary to utilize the inertial-guidance system itself to satisfactorily evaluate high-performance gyros. Advantages and disadvantages of each method are presented from both the technical and the cost viewpoints. Author

N71-13208# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

PRECISION INERTIAL GYRO TESTING AT MIT

P. J. Palmer, ed, W. A. Gianoukos, W. C. Donovan, F. E. Cartwood, A. J. Smith et al *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 179–282 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn: Mr. A. L. Candido)

One philosophy of inertial gyro testing is that the test program should provide accurate measurements of the coefficients of a model equation that mathematically defines the gyro performance in any environment. The reduction of this philosophy to practice is described as it relates to the testing of the single degree of freedom floated integrating gyro to today's high performance, high reliability, and long life specifications. After defining basic terms and nomenclature, the error model for the gyro is developed. Laboratory testing in both the one-g and the higher than one-g environments is then described in considerable detail as are the data processing techniques involved. A discussion of two degree of freedom gyro testing elsewhere is included. Author

N71-13207# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

TESTING THE PRECISION ACCELEROMETER

M. S. Sapuppo, P. J. Pijoan, and J. H. Buchanan *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 283–365 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The success of inertial guidance systems for vehicles navigating anywhere between outer space and the deepest sea bottom is directly dependent on the performance of the inertial reference gyro and the specific force receiver (accelerometer) as the primary position and motion sensing transducers. Considered is what, why, where and how to test the inertial quality accelerometer, based on experience with the pendulous integrating gyro accelerometer (PIGA) and the pulsed integrating pendulous accelerometer (PIPA). As part of the development of an accelerometer, tests must be designed to determine the magnitude and stability of the performance parameters. A general review of the philosophy of testing the PIGA and PIPA is presented, including the major testing emphasis, the parameters to be measured, the optimum level of assembly at which to apply a test, the factors causing changes in the tests and the method of performing tests. Testing procedures for the inertial accelerometer considered are tumbling, vibratory loads, and centrifugal accelerations. Mathematical models of expected performances are reviewed and recommended data analysis techniques are presented. Author

N71-13208# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

TESTING AND ACCEPTANCE OF INSTRUMENTS AT A SYSTEM LEVEL

Kenneth Fertig *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 367–407 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

In the course of an inertial system development, when the instruments arrive and the platform with its electronics is to be assembled, a trade-off arises; considered is to what level should instruments be acceptance tested and calibrated as components rather then integrated into the platform and tested together in a system-like environment. Overall system costs are decreased when most of the instrument testing is done in the final use environment. The savings result through a decrease in expenditure for test equipment, and a requirement that instruments work properly in the final assembly prior to being accepted and that the greater fraction of total test and acceptance time spent in the system environment provide more useful data to operationally deploy the system. The philosophy of system level testing is expanded as to be applicable to the research, development and prototype phases of system and instrument development as well as the production phase. Author

N71-13209# Royal Aircraft Establishment, Farnborough (England).

GYRO TESTING TECHNIQUES IN THE UK

J. V. Carter *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 409–451 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn: Mr. A. L. Candido)

Two basic test methods—single axis servo table and rate mode—are discussed and several types of tests commonly in use in the UK are described, with a full analysis given in the appendices. The test data and the possible uses made of it when taken under simulated platform conditions are examined to establish the suitability of a gyro design for a particular application. Reviewed is the more important British designed gyro test equipment in relation to the tests discussed; the problems of laboratory facilities and layout, including the siting of working test pads and the realistic requirements for their stability, are included. Author

N71-13210# Royal Aircraft Establishment, Farnborough, (England).

DIAGNOSTIC TESTING AND DESIGN SHORTCOMINGS IN PRECISION GYROSCOPES

O. H. Wyatt *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 453–463 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Several tests of precision gyroscopes are discussed which aim to diagnose possible shortcomings in their design; tests used to determine the standard drift rate coefficients are not included. Diagnostic testing establishes the source of unsatisfactory values, or stability, of the drift coefficients; of determining the gyro performance in arduous environmental conditions; and of predicting the likely lifetime during which the coefficients will be maintained. Discussed are certain critical design features of gyroscopes, particularly of the single degree of freedom floated type, and it is shown how diagnostic testing on complete gyros can be used to establish whether the gyro designer and manufacturer have found satisfactory solutions to the problems. Author

N71-13211# Centre d'Essais en Vol, Bretigny-Sur-Orge (France). Lab. d'Equipements Aeronautiques.

SCALE FACTOR MEASUREMENT OF MOTORS [MESURE DU FACTEUR D'ECHELLE DES MOTEURS-COUPLES]

D. Berard *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 465–484 In FRENCH (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

An investigation is made to explore the diverse results obtained by classical procedures on the drift of the gyroscope. An analysis of different possible configurations, utilization of different measuring methods, and the work which permits the partial freeing of the drift is given. The tests and the results on the stability of the linear scale factor influenced by the temperature are given. Transl. by E.H.W.

N71-13212# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

A 10g TABLE AND THE REQUIREMENTS OF GYROSCOPIC MATERIALS UNDER ACCELERATION [UNE TABLE 10G ET LE COMPORTEMENT DE MATERIELS GYROSCOPIQUES SOUS ACCELERATION]

E. Holivier *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 485–523 refs In FRENCH (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn: Mr. A. L. Candido)

Through the theory plan, linear sinusoidal acceleration of three low frequencies for the study of the drift of a gyroscope is presented. Also presented are some performances of the instrument and the mean inertial tests from the Laboratory of Ballastics and Aerodynamics. A number of examples, test methods, and the stripping utilized for the evaluation of two gyroscopic materials are given. The gyroscope has two axial joints and a gyrometer. Transl. by E.H.W.

N71-13213# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

STUDY OF LINEAR MOTION OF ACCELEROMETERS ON CENTRIFUGE [ETUDE DES ECARTS DE LINEARITE DES ACCELEROMETRES SUR CENTRIFUGFUSE]

C. Mauffret *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 525–545 refs In FRENCH

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc. 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A review is given of the tests on the centrifuge for determining the linear motion of accelerometers. Also described are test methods, and current results are analyzed. The precision study of the tests on the centrifuge and the specifications which responds to a high precision centrifuge are discussed. Finally, the review gives the characteristics of a centrifuge point placing for the Laboratory of Ballistics and Aerodynamics Research. Transl. by E.H.W.

N71-13214# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).

TESTING OF GYROS AND ACCELEROMETERS WITH HYDROSTATIC GAS BEARINGS

W. Auer, W. Fehse, and A. Wand *In* AGARD Inertial Component Testing: Philosophy and Methods Jul. 1970 p 547–580 refs (See N71-13201 03-21)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The testing of gyros and accelerometers using hydrostatic gas bearings for the sensitive axis is discussed. These inertial sensors are briefly described. The development of the gas bearing rate gyro GWK 38 was started in 1965, that of the gas bearing accelerometer GBM 531 in 1966. Parallel to this an adequate testing philosophy was gained. For the gyros it represents the

procedures suited for development and production of small quantities; for the accelerometer so far only developmental points of view are of interest. To get comparable data wherever possible, known testing principles were adopted. Some of the test results are given. Author

N71-13281# Technische Hochschule Stuttgart (West Germany). Inst. fuer Mechanik.
BEHAVIOR OF A GYROCOMPASS AND A GYRO HORIZON WHILST LOOPING [VERHALTEN VON KURSKREISEL UND KREISELHORIZONT BEIM LOOPING]
Joerg-Ulrich Steinwand (Ph.D. Thesis) 1970 103 p refs In GERMAN
Avail: NTIS

The behavior of attitude gyros with stops on the inner frame is investigated during a looping flight. The stops limit the freedom of rotation of the inner frame to approximately + or − 80 to + or − 85 deg and may be fixed or flexible. It is checked, under which conditions the inner frame is stopped and how hard the flexible stops have to be, to prevent blocking the frame. A precession takes place due to a moment working on the gyro as the inner frame is on one of its stops. At the end of the looping this results in an indication error, which is investigated. ESRO

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N71-12589# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. TOPICAL REPORT NO. 10: CREEP OF T-111 RADIOISOTOPE CONTAINMENT VESSELS UNDER INCREASING PRESSURE
P. B. Ferry 3 Jul. 1970 114 p refs
(Contract AT(29-2)-2338)
(AI-AEC-12943; Rept-10) Avail: NTIS

A program designed to develop and test an analytical model for creep of T-111 fuel capsule under operating conditions is described. The results of testing the model under increasing pressure at 2000 F using He pressurizer gas are summarized. NSA

N71-12588*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MALFUNCTION ANALYSIS OF A CONCEPTUAL SPACE POWER FAST-SPECTRUM REACTOR
John A. Peoples Washingto Dec. 1970 28 p refs
(NASA-TM-X-2057; E-5690) Avail: NTIS CSCL 18E

Four types of reactor malfunctions were examined: (1) control drum run-in, (2) reduction of coolant flow, (3) reduction of coolant inlet temperature, and (4) complete loss of coolant. The results show that this reactor concept exhibited an inherent safety factor due to its relatively slow response to each of these malfunctions. With the reactor at cold critical, reactivity insertions should be limited to a safe margin below 9.7 cents per second to avoid a prompt critical condition. Normal coolant velocity per channel (3.95 ft/sec or 1.20 m/sec) can be reduced to almost 10 percent of design before fuel temperatures approach 2500 R (1389 K). A step decrease of 210 R (117 K) in the normal coolant inlet temperature (2100 R or 1667 K) still provides a safety margin of almost 40 sec before fuel temperatures reach 2500 R (1389 K). Six sec are required following a complete loss of coolant accident for fuel temperatures to reach 2500 R (1389 K). Author

N71-12570# Argonne National Lab., Ill.
MINUTES: SPECIALISTS MEETING ON SODIUM-WATER REACTIONS
Kurt Goldman 15 Oct. 1969 56 p refs Held at Argonne, Ill., 5–6 Nov. 1968; sponsored by Intern. Atomic Energy Agency
(UNC-SPLM-1059) Avail: NTIS

The minutes for the specialists meeting for the United States team, a list of participants, a reference list, and the panel discussions containing summary reports on the specialists' meeting are presented. NSA

N71-12571# Bettis Atomic Power Lab., Pittsburgh, Pa.
EFFICIENCY OF LAGUERRE AND LEGENDRE QUADRATURES IN SHIELDING CALCULATIONS
K. Shure, L. M. Swartz, and O. J. Wallace Apr. 1970 18 p refs Presented at the Am. Nucl. Soc. Meeting, Los Angeles, Jun. 1970
(Contract AT(11-1)-GEN-14)
(WAPD-T-2330; CONF-700608-19) Avail: NTIS

The accuracies of Laguerre and Legendre quadrature techniques for numerical integration of the exponential point kernel over a line source were evaluated. Results indicate that the relative efficiency of the Laguerre versus the Legendre technique is dependent on the location of the field point with respect to the integration interval. There are areas where the Laguerre technique is more efficient, but there are other areas such as those encountered in studies of axial and/or azimuthal variation of fluxes from cylindrical sources where the Legendre technique is more efficient. For volume integrals applying three one-dimensional quadratures, a combination of Laguerre and Legendre quadratures can be more efficient than exclusive use of either quadrature technique. Author (NSA)

N71-12800# Oak Ridge National Lab., Tenn. Chemical Technology Div.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report, Jun. 1970
Aug. 1970 24 p ref
(Contract W-7405-eng-26)
(ORNL-TM-3088; PR-11) Avail: NTIS

Development work on HTGR fuel recycle is reported under the following headings: head-end reprocessing development, refabrication development, materials irradiation, and U-233 reprocessing. NSA

N71-12642# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM: TOPICAL REPORT NO. 12: TRANSIT CAPSULE PROCESS METALLURGY
Robert G. Brengle 3 Jul. 1970 50 p ref
(Contract AT(29-2)-2338)
(AI-AEC-12967; Rept-12) Avail: NTIS

T-111 (Ta −8W −2Hf), Ta −10W and Pt-20Rh piece parts were fabricated for the Transit and Pioneer flight qualification programs. The metallurgical characteristics of the piece parts are described by using photomicrographs of various areas. Even though some process variations took place during the program the photomicrographs from the various capsules show that very little difference occurs in the final microstructure. Author (NSA)

N71-12687# Idaho Nuclear Corp., Idaho Falls.
DIGITAL COMPUTATION OF POWER SPECTRAL DENSITY CURVES FROM REACTOR NOISE DATA
Barry Jay Kramer Jun. 1970 189 p refs
(Contract AT(10-1)-1230)
(IN-1374) Avail: NTIS

The feasibility of doing power spectral density analysis of reactor noise data on a small general purpose digital computer was investigated. The fast Fourier transform algorithm of Cooley and Tukey was employed to transform data from the time to the

frequency domain. A program was first written for the larger IBM-7044 computer which had sufficient core memory to transform up to 8192 discrete points. Results were confirmed by an independent check and comparison of results obtained by analyzing the same data on an analog computer. Statistical properties of the noise data were also checked and it was found to be random, normally distributed, and stationary. Author (NSA)

N71-12688# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Jun. 1970
31 Jul. 1970 196 p refs
(Contract W-31-109-eng-38)
(ANL-7705) Avail: NTIS

Highlights of project activities for June 1970 are summarized. LMFBR physics development and component development are reviewed. Operations and analysis of ZPR-3, ZPR-6, ZPR-9, and ZPPR are described. The EBR-2 research and development projects, fuel fabrication, and operations are summarized. Reactor fuels and materials development, physics studies, engineering development, fuel cycle chemistry, and LMFBR safety studies are reported. NSA

N71-12689# Oak Ridge National Lab., Tenn. Chemical Technology Div.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report, Jul. 1970
Aug. 1970 14 p
(Contract W-7405-eng-26)
(ORNL-TM-3112; PR-12) Avail: NTIS

Development work on HTGR fuel recycle is reported under the following headings: head-end reprocessing development, refabrication development, TURF equipment design and engineering, and materials irradiation. NSA

N71-12690# Los Alamos Scientific Lab., N.Mex.
REPORT ON Pu 238 SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM Quarterly Status Report, 1 Jan. -31 Mar. 1970
Jul. 1970 17 p refs
(Contract W-7405-eng-36)
(LA-4476) Avail: NTIS

Efforts during the quarter were primarily devoted to the production of solid solution cermets (SSC). A total of 1.1 kg of 90 wt % Pu-238O2 - ThO2 was prepared in the size range 105 to 177 micron. Production processes are outlined along with processes for coating ceramic powder by chemical vapor deposition of Mo. A series of property tests were conducted on PuO2 - ThO2 - Mo cermets and on simulated cermets. Results of these and compatibility tests with refractory alloy container material are summarized. Results of radiation effects testing are also summarized with emphasis on He production and release and dose rates from SSC. NSA

N71-12733# Argonne National Lab., Ill.
SODIUM TECHNOLOGY Quarterly Report, Jan. -Mar. 1970
M. Ader and G. Kesser, eds. Jul. 1970 95 p
(Contract W-31-109-eng-38)
(ANL/ST-2) Avail: NTIS

The research, development, and management efforts are reported in the following areas: development and testing of on-line instrumentation for monitoring oxygen, carbon, and hydrogen in LMFBR sodium and for detecting leaks in LMFBR steam generators; drafting of a program for setting up standard analytical methods to meet the needs of the national sodium technology effort, and the development of methods for the determination of trace amounts of oxygen, carbon, nitrogen, and metallic impurities in sodium; definition of problems created by the radioactivity in the primary sodium system and cover gas of reactors, the development of means to detect and evaluate fuel failures, and a study of the kinetics and mechanism of formation of sodium aerosol; studies of the transport of carbon in sodium-steel systems and of the adequacy of vanadium alloys as cladding for LMFBR fuels; development of purification methods for removing contaminants from primary coolant sodium; and studies of the chemistry of carbon- and nitrogen-bearing species in liquid sodium and of the solubility of xenon. Author (NSA)

N71-12746# Oak Ridge National Lab., Tenn.
INVESTIGATION OF DEFORMATION IN RECTANGULAR Cs 137 SOURCES
N. C. Bradley and C. L. Ottinger Aug. 1970 29 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3069) Avail: NTIS

Results are presented of inspection and data review of Cs-137Cl strip sources to determine causes of deformation in these standard assembly sources which had passed all applicable tests. Information is included on source design, encapsulation materials, fuels, assembly, and testing. No single cause was found for the deformations. Indications of areas in which fabrication methods can be improved were found and recommendations based on these findings are presented. NSA

N71-12809# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
DESIGN OF A REPAIR DEVICE FOR A SODIUM-SODIUM HEAT EXCHANGER [ENTWURF EINER REPARATURVORRICHTUNG FUER EINEN NATRIUM/NATRIUM-ZWISCHENWAERMETAUSCHER]
M. Cramer, U. Hitzschke, and G. F. Schultheiss Oct. 1969 35 p In GERMAN
(NP-18292) Avail: AEC Depository Libraries

The preliminary repair steps of a Na/Na-heat exchanger are briefly described. Some possibilities of blockage of destroyed tubes are discussed. For final design, a manipulator and the explosive welding of the tube-plugs were chosen. This method was independent of the heat exchanger tube design and needed no difficult cleaning processes. A description of the design and the handling is given. Author (NSA)

N71-12810*+ Oak Ridge National Lab., Tenn.
SYNTHESIS, CHARACTERIZATION, AND FABRICATION OF UN
V. J. Tennery, T. G. Godfrey, and R. A. Potter Dec. 1970 22 p refs
(NASA Order C-51092-B)
(NASA-CR-72764; ORNL-4608) Avail: NTIS CSCL 18J

Procedures were developed for synthesizing fine uranium nitride powders that contain less than 200 ppm O from uranium metal by the hydride-dehydride-nitride process. A method was established, based on the principle of gas sedimentation, as suitable for measuring the distribution of particle sizes and it was found that 80% of the particles were between 1 and 7 micrometers in diameter. Scanning electron microscopy showed that the particles were very irregularly shaped and that each particle had several protrusions from the surface, which explains the difficulty in fabricating these powders. Uranium mononitride (UN) cylinders were fabricated by both uniaxial and isostatic pressing. Uniaxial pressing required additives such as camphor to act as a binder and die lubricant, but the addition of camphor resulted in about 1000 ppm O in the sintered product. Isostatic pressing required no additives and typically resulted in a sintered product with less than 300 ppm O. Author

N71-12823# Atomic Power Development Associates, Inc., Detroit, Mich.
CRITERIA FOR DETECTION OF SMALL SODIUM-WATER REACTIONS IN LMFBR STEAM GENERATORS

J. A. Ford, H. V. Chamberlain, J. H. Coleman, and P. S. Lindsey Jun. 1970 119 p refs
(Contract AT(11-1)-865)
(APDA-255) Avail: NTIS

An evaluation of various candidate instruments for the detection of small leaks was conducted for the purpose of developing leak detection systems for sodium-heated steam generators. Criteria developed require detection of a leak in sufficient time to allow for shutdown of the steam generator before significant repairs are necessary; or, alternatively, to require shutdown before secondary tube failures have occurred. Evaluation of preliminary data obtained during material wastage tests in a large sodium-water reaction test facility was made to determine the disposition of reaction products formed during the reaction. The major elements and input required for the analysis of leak detection are described and, for illustrative purposes, an analysis of leak detection are described and, for illustrative purposes, an analysis of a reference secondary system for a 1000-MW(e) LMFBR plant is presented. Although the analysis applies only to the system described, it illustrates the method needed for performing such an analysis. Evaluation of the candidate instruments revealed that the most promising detectors are the electro-chemical oxygen meter and the APDA hydrogen meter. The acoustic detector has undergone a minimum amount of development; however, limited experimental data indicate that it has the greatest potential for fulfilling the criteria for leak detection. Author (NSA)

N71-12824# Panametrics, Inc., Waltham, Mass.
ULTRASONIC THERMOMETRY IN LMFBR SYSTEMS Progress Report, Period Ending 30 Jun. 1970
E. P. Papadakis, D. R. Patch, L. C. Lynnworth, and E. H. Carnevale 30 Jun. 1970 12 p
(Contract AT(30-1)-3906)
(NYO-3906-11) Avail: NTIS

Several models of the ORTC-4 composite sensor were tested in a furnace and a modification of the design was decided upon. The FFTF centerline sensor simulation design was finalized and the parts procured or ordered. The electromagnetic connector-transducer for manipulation under liquid sodium was built and tested at room temperature. The method for heating and simulated sensor was decided, and work on the heating apparatus is progressing. Part of this work continues to be the installation of the tungsten tube furnace. Author (NSA)

N71-12841# Atomics International, Canoga Park, Calif.
USER'S MANUAL FOR THE SOURCE TERM COMPUTER PROGRAM (STP-1) FOR COMPUTING THE DISTRIBUTION OF CORROSION AND FISSION PRODUCTS IN LMFBR'S
G. B. Zwetzig 15 Jul. 1970 99 p refs
(Contract AT(04-3)-701)
(AI-AEC-12957) Avail: NTIS

A manual for use of the Source Term Computer Program (STP-1) is presented. This program, written for the IBM 360, calculates the generation and transport of fission products and activated structural materials in a Liquid Metal-Cooled Fast Breeder Reactor (LMFBR) for user-selected cladding failure rates and core corrosion rates. The program also calculates Na-24 and Na-22 specific activities in the coolant, and radiation levels in the vicinity of the primary loop. A subroutine for plotting selected quantities is also included. The manual describes the equations used in the calculations, and presents the input data and output for a sample problem. Author (NSA)

N71-12871# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DIVISION OF ISOTOPE DEVELOPMENT PROGRAMS Quarterly Report, Feb. – Apr. 1970
J. E. Hansen, ed. May 1970 66 p refs
(Contract AT(45-1)-1830)
(BNWL-1308-2; QR-14) Avail: NTIS

Results of investigations of isotopic fuels are presented. Data and information are included on laser uses, Pm compatibility, waste Cs as radiation source, characteristics of fission product Rh and Pd, uses of fission product Xe, radiography using Cf-252, source development, power reactor isotope production, isotopic heat sources for circulatory assist devices, and nuclear methods for seabed prospecting. NSA

N71-12872# Los Alamos Scientific Lab., N.Mex.
NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT Program Status Report, Jan. – Apr. 1970
Jun. 1970 41 p refs
(Contract W-7405-eng-36)
(LA-4457-MS) Avail: NTIS

Research and development are reported on neutron interrogation and nondestructive assay of fissionable materials, passive gamma radiation methods, passive neutron methods, nuclear instrumentation and apparatus development, computational and data acquisition facilities, mobile assay laboratory, accelerators, neutron source development, and facility development. NSA

N71-12873# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC) Quarterly Progress Report, Apr. – Jun. 1970
3 Jul. 1970 77 p
(Contract AT(29-2)-2338)
(AI-AEC-12968; QPR-12) Avail: NTIS

Efforts devoted to hardware design and fabrication for other tasks are summarized. Progress on creep testing is reported along with capsule materials compatibility testing and transit capsule support research. Results of transit heat source verification tests are reported and a tabulation of transit capsule pieceparts is included. NSA

N71-12879# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.
REVIEW OF THE GASEOUS OXIDATION OF PYROCARBON AND OF THE BOUDOUARD REACTION
A. C. Collins, D. A. Dominey, and T. Swan May 1970 24 p refs
(RD/B/N-1588) Avail: AEC Depository Libraries

Literature on the thermal oxidation of the pyrocarbon coatings of fuel particles and the associated compacting material by carbon dioxide and water vapor is reviewed together with data on the thermal deposition of carbon from carbon monoxide. The extrapolation of these data to high temperatures and to both high and low gas pressures is discussed. The rates of radiolytic oxidation and carbon deposition are estimated and compared with the rates of the corresponding thermal reactions. Author (NSA)

N71-12880# Atomic Energy Establishment, Winfrith (England). SGHW Development Div.
REACTOR PERFORMANCE CALCULATIONS FOR WATER REACTORS
D. Hicks Apr. 1970 243 p refs
(AEEW-R-691) Avail: AEC Depository Libraries

The principles of nuclear, thermal and hydraulic performance calculations for water cooled reactors are discussed. The principles are illustrated by describing their implementation in the UKAEA PATRIARCH scheme of computer codes. Author (NSA)

N71-12887# United Kingdom Atomic Energy Authority, Risley (England). Authority Health and Safety Branch.
ASSESSMENT OF ENVIRONMENTAL HAZARDS FROM REACTOR FISSION PRODUCT RELEASES
J. R. Beattie and Pamella M. Bryant May 1970 88 p refs
(AHSB(S)R-135) Avail: AEC Depository Libraries

Information is reviewed pertaining to quantities of fission products formed in the fuel of large power reactors, the likelihood

of certain of these escaping if an accident occurred, modes of dispersion and deposition of accidental discharges to the atmosphere, ways in which radiation dosage could be received downwind of a release, and the magnitude of such doses in various weather conditions and at different distances downwind. Possible consequences are depicted of the low probability accidents commonly postulated for AGR, PWR, BWR and SGHW type reactors. Calculations embody recent moderate relaxations in emergency reference levels of activity concentrations, which are due to improvements in the radiobiological data. Conclusions reaffirm the importance of I as a primary source of hazard by inhalation, and by ingestion through milk and other foods. It is concluded that the whole body dose from the cloud is only a serious hazard if the release is very large and also within 1 km or so downwind of the reactor. Supplementary graphs are given for separate evaluation of hazards from Sr, Cs, Ru and the noble gases. Author (NSA)

N71-12890# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

MODEL OF SELF CONTROL THROUGH BOILING IN POWER EXCURSIONS OF A WATER COOLED REACTOR [MODELLO DI AUTOSPEGNIMENTO PER EBOLLIZIONE NELLE ESCURSIONI DI POTENZA DI REATTORI AD ACQUA]

M. Michelini and S. Petrarca 14 Nov. 1969 49 p refs In ITALIAN

(RT/FI-(69)51) Avail: AEC Depository Libraries

The negative void coefficient provides a useful self control in the power excursions of water moderated reactors. A model is presented which allows the calculation of the reactivity effect produced by subcooled boiling during excursions in pool water reactors at source power level. An application was carried out by means of analog computer. Author (NSA)

N71-12895*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONCEPTUAL DESIGN OF A 150 kWe OUT-OF-CORE NUCLEAR THERMIONIC CONVERTER SYSTEM

James J. Ward, Roland Breitwieser, and Richard M. Williams 1970 22 p Presented at the 1970 Thermionic Conversion Specialists Conf., Miami, Fla., 26–29 Oct. 1970; sponsored by Inst. of Elec. and Electron. Engr.

(NASA-TM-X-52933) Avail: NTIS CSCL 18E

Nuclear thermionic systems with the thermionic converters outside the reactor were reexamined in the perspective of several recent technical advances: new high temperature, corrosion resistant, high strength alloys; high heat flux heat pipes; improved thermionic converters, and light weight, vapor cooled radiators. These were combined to yield a new look to the out of core approach. A versatile, compact reactor is the result. Insulators are eliminated by the use of heat pipes as electrically resistive elements; and weights are reduced by combining vapor cooled radiators, structural supports, and current leads into vapor cooled radiator modules. The overall design is also highly modular and thus provides high reliability and a reduction in development time and costs. Author

N71-12896# Japan Atomic Energy Research Inst., Tokai. Research Establishment.

PROF GROUCH-G: A PROCESSING CODE FOR GROUP CONSTANTS FOR A FAST REACTOR

Tatsuzo Tone and Satoru Katsuragi Nov. 1969 22 p refs

(JAERI-1192) Avail: AEC Depository Libraries

The code PROF GROUCH-G was developed for producing fast reactor group constants by processing directly the nuclear data given by ENDF/A formats. The characteristic features of the code are as follows: (1) All data of DCC 1, 2, 6, 9 and 10 formats can be treated. (2) Calculations of different nuclides, reaction and data types can be continuously carried out and the respective results are obtained. (3) For the angular distribution data of elastic and inelastic scattering, the energy transfer probabilities are in detail calculated by using the conservation law of momentum and energy. (4) Smooth spectra phi sub s(E) used for averaging cross sections are fission spectrum and 1/E sup alpha. Composition dependence of cross sections is taken into account. UKNDL and ENDF/B data also can be processed. The PROF GROUCH-G is written for IBM 360/75 and FACOM 230/60. Author (NSA)

N71-12920# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.

SELF-WELDING OF REACTOR STRUCTURAL MATERIALS UNDER SODIUM AT HIGH TEMPERATURES [SELBSVERSCHWEISSEN VON REAKTURSTRUKTURWERKSTOFFEN UNTER NATRIUM BEI HOHEN TEMPERATUREN]

K. Benndorf Apr. 1970. 39 p refs In GERMAN

(NP-18289) Avail: AEC Depository Libraries

The self-welding tendency of structural materials was investigated by static load tests in sodium. Besides austenitic materials, a stabilized ferritic steel, a nickel base alloy and several hard facing and hard metal alloys were tested. The test temperatures were 580 and 700 C, the compressive load ranged up to 5 kg/sq mm, and the tests lasted for 168 hrs. The oxygen content of the cold-trapped sodium was nearly 20 ppM. The results show a more or less pronounced tendency of all the materials to weld together. While the austenitic and ferritic steels showed a marked tendency to weld together at 700 C, the behavior of the hard facing and the hard metal alloys was not uniform. The nickel base alloy did not weld together, with one exception. Micrographs made of some different material combinations seem to indicate that the welding was caused by recrystallization after previous strong deformation of the contact region. Author (NSA)

N71-12921# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

STUDY OF THE USE OF Gd IN A BOILING WATER REACTOR

P. Coari and S. Lopez 9 Apr. 1970 68 p refs In ITALIAN

(RT/FI-(70)20) Avail: AEC Depository Libraries

Gaddinium addition to the fuel makes possible the reduction of the control system dimension in a nuclear reactor. A design calculation of Gd addition to a Pu fuel assembly of the type employed in a BWR is presented. This study points out that a reduction of control system dimension of 75% can be achieved by means of Gd addition. Power distribution alteration is not so large as to proceed again to a new optimization study of the fuel element. Author (NSA)

N71-12922# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.

RADIAL DISTRIBUTION OF BUBBLES IN SODIUM FLOWING THROUGH HEATED CHANNELS

P. K. Holland Mar. 1970 11 p refs

(RD/B/N-1630) Avail: AEC Depository Libraries

Expressions are obtained for the forces on small bubbles in heated turbulent flows. These expressions show that argon bubbles in the sodium coolant flowing through a fast reactor core will be concentrated near the fuel pins. Author (NSA)

N71-12976# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

PHYSICAL FOLLOW-UP OF EBWR OPERATION BY NUCLEAR CODES DEVELOPED BY CNEN. PART 2: BURN-UP AND POWER DISTRIBUTION CALCULATIONS

P. Coari, S. Lopez, and M. Michelini 21 Nov. 1969 63 p refs

(RT/FI-(70)1) Avail: AEC Depository Libraries

The physical follow-up of the EBWR plant operation is discussed regarding: (1) reactivity and power distributions during burnup; (2) revision of the preceding K(eff) calculations; and (3) minimum Pu critical after final shutdown. Author (NSA)

N71-13064*# AiResearch Mfg. Co., Phoenix, Ariz.
NUCLEAR BRAYTON TURBOALTERNATOR-COMPRESSOR (TAC) CONCEPTUAL DESIGN STUDY Final Report
E. A. Mock and J. E. Davis Sep. 1970 328 p refs
(Contract NAS3-13448)
(NASA-CR-111565; APS-5355-R) Avail: NTIS CSCL 18L

The general configuration, design variation, and conceptual design analyses of a 160-kW Brayton rotating assembly are described, and details are given of the component studies. Radial and axial compressors, with gas, rolling, and oil film bearings, were investigated. The configuration selected incorporates a radial compressor, radial turbine, Lundell alternator, and gas bearings. A 2-pole 400 Hz TAC unit was found to be practical but heavier and less efficient than a 6-pole 1200 Hz unit, and also might result in shaft distortions due to the nonsymmetry of the 2-pole configuration. It is concluded that the TAC will operate efficiently at the SNAP 8 reactor temperature levels and that the capability for efficient operation at 1144 K turbine inlet temperature is maintained. N.E.N.

N71-13337*# Technische Hochschule Stuttgart (West Germany). Inst. fuer Kernenergetik.
SUITABLE DESIGN OF THERMAL EXCLUSIVELY THERMIONIC REACTORS WITH HOMOGENEOUS EMITTER HEATING FOR SPACE APPLICATION [ZWECKMAESSIGE AUSLEGUNG VON THERMISCHEN VOLLTHERMIONIK-REAKTOREN MIT KONSTANTER EMITTERAUF HEIZUNG ZUR ANWENDUNG IN DER RAUMFAHRT]
Suemer Sahin (Ph.D. Thesis) 1970 78 p refs In GERMAN
(Repf-6-45) Avail: NTIS

A thermionic reactor for electric power generation has been calculated, attempting to achieve a highly compact reactor design with high specific power and homogeneous emitter heating to satisfy the requirements of converter physics. The neutron energy distribution has been calculated using a 49 group neutron scattering program. Critical considerations showed that homogeneous emitter heatig slightly reduced the multiplication constant. A comparison with a partial thermionic reactor showed that the specific power output for this design is almost twice as high. ESRO

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N71-12588*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTROMAGNETIC SCATTERING BY CYLINDERS: AN INTRODUCTION
G. A. Gary and P. D. Craven 16 Sep. 1970 68 p refs
(NASA-TM-X-64545) Avail: NTIS CSCL 20C

The theory of electromagnetism is reviewed, and the theory of light scattering is developed. The general features of scattering by cylinders are presented by use of the Rayleigh–Gans theory. Author

N71-12597*# Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY OF MAGNETIC MATERIALS AND TABULATION OF MAGNETIC TRANSITION TEMPERATURES
T. F. Connolly and Emily D. Copenhaver, comps. Jul. 1970 118 p refs Revised
(Contract W-7405-eng-26)
(ORNL-RMIC-7-Rev-2) Avail: NTIS

Two lists are presented alphabetically by material, one for Curie and one for Neel temperatures. A total of 1773 references is included. NSA

N71-12764*# Wisconsin Univ., Stoughton. Physical Sciences Lab.
OPERATION OF ACCELERATOR-STORAGE RING TO PROVIDE ULTRAVIOLET RADIATION Final Report
Frederick E. Mills, Ednor M. Rowe, and Charles H. Pruett Sep. 1970 10 p refs
(Grant AF-AFOSR-1553-68)
(AD-712715; AFOSR-70-1129TR) Avail: NTIS CSCL 20/6

The paper reports on the operation of the electron storage ring as the source of ultraviolet radiation for the performance of experiments in solid state, atomic, and surface physics. The highest priority effort was to improve injection optics thereby offering the largest immediate improvement in intensity. In order to make more efficient use of the facility it was the objective to increase the number of ports available for experiments. A higher power amplifier for the radio frequency system was also planned in order to obtain currents in the multi-ampere range. Author (TAB)

N71-12874*# Stanford Linear Accelerator Center, Calif.
HIGH-FIELD MAGNETS WITH AND WITHOUT FERROMAGNETIC RETURN YOKES
H. Brechna and J. Perot Jun. 1970 42 p refs Presented at the 3d Intern. Conf. on Magnet Technol., Hamburg, West Germany, 19–22 May 1970
(SLAC-PUB-739; CONF-700503-5) Avail: NTIS

The effect of ferromagnetic materials on field enhancement and field distribution in a useful magnet aperture is discussed. Also treated are the effects of perturbations due to manufacturing constraints. The field distribution is calculated in the presence or absence of iron return yokes. Computational results are compared to simplified first-order calculation methods utilizing uniform permeability distribution or infinite permeability in iron. To show the extent of perturbations due to coil manufacturing upon field or gradient homogeneity in beam transport magnets, a calculating method based on complex variables is used. Field or gradient distribution in the coil aperture, due to ideal current density distribution, is compared to flux densities or field gradients when the ideal coil configuration has been modified to a more practical shape. Current filaments (multipoles) are used to correct for field inhomogeneities. Computer calculations have their limitations due to convergence problems, size limitation, digitalization and boundary effects. Based on a practical 8th-order coil, a computational method is illustrated. Author (NSA)

N71-12875*# California Univ., Berkeley. Lawrence Radiation Lab.
MAGNETIC FIELD CALCULATIONS FOR THE 184-INCH SYNCHROCYCLOTRON
A. C. Paul and J. S. Colonias Feb. 1970 19 p refs
(Contract W-7405-eng-48)
(UCRL-18882) Avail: NTIS

Experience with the use of a computer program to calculate the magnetic field change produced by a change in the coil excitation of the Berkeley 184-inch synchrocyclotron is described. One of the interesting aspects of these calculations is the simulation of the magnet with a cylindrical pole face and a rectangular return yoke. The raw computed magnetic field compares to the azimuthally averaged measured field at the same excitation to within 1%. A subtraction technique is used to cancel integration and systematic model errors and yields a calculated magnetic field that compares to within 0.1% with the measured fields at different excitations. The calculations include the effects of the plate construction (stacking factor) of the magnet and assume median-plane symmetry, but do not include the small effects produced by the main-coil current symmetry shunts and nonuniform current distribution, although these could have been included. Author (NSA)

N71-12886# Tennessee Univ., Knoxville. Dept. of Physics.
ELECTRONIC PROPERTIES OF LIQUIDS Annual Progress Report, 1 Nov. 1969 - 31 Oct. 1970
Linda R. Painter Jul. 1970 24 p refs
(Contract AT(40-1)-3861)
(TID-25478) Avail: NTIS

Reflectance data of Dow Corning 704 and 705 diffusion pump oil (tetramethyltetraphenyltrisiloxane and trimethylpentaphenyltrisiloxane) were taken with sufficient accuracy to allow determination of the optical and dielectric constants and the energy loss function. Preliminary measurements were made on Dow Corning 200, dimethylpolysiloxane, to see if the response of the methyl groups is similar to that in DC-704 and 705. Simultaneous with studies of silicone oils, construction of a new liquid reflectance apparatus was completed. The cell and monochromator was leak tested. The following associated equipment necessary for the apparatus to be placed in operating condition was designed and constructed: a hoist for positioning the movable monochromator, a light pipe and holder with a positioning mechanism, a light filter assembly, flanges with corrugated stainless steel hose for attaching the pumping assembly to the rotating differential pumping parts, and a circulating coolant system to the cell. A new polarizer was constructed to measure the grating polarization. Author

N71-12982# Institut Franco-Allemand De Recherches, St. Louis (France).
APPLICATION OF DIFFERENTIAL INTERFEROMETRY IN POLARIZED LIGHT TO THE VOLUME DETERMINATION IN WAKES OF SPHERES IN HYPERSONIC FLIGHT AT LOW PRESSURE [APPLICATION DE L'INTERFEROMETRIE DIFFERENTIELLE EN LUMIERE POLARISEE A LA DETERMINATION DES MASSES VOLUMIQUES DANS LES SILLAGES DE SPHERES EN VOL HYPERSONIQUE A BASSE PRESSION]
F. Albe, P. Smigielski, L. Oudin, and M. Jeanmaire 3 Mar. 1970 16 p refs In FRENCH
(ISL-T-12/70) Avail: NTIS

The density distribution in the entropic wake of a sphere traveling at 3.3 to 5.5 km per second and at pressures from 100 and 60 Torr is determined with the help of an interferometric system in polarized light. The theoretically determined effect of projectile velocity on the width of the entropic wake is evaluated experimentally. Author

N71-12987# McElroy (Ralph) Co., Austin, Tex. Custom Div.
FUTURE TRENDS IN CYROELECTRICAL TECHNOLOGY
J. Fabre [1970] 23 p Transl. into ENGLISH from Bull. Inst. Intern. Froid, Annexe (Paris), no. 1, 1969 p 441-445 Prepared for Los Alamos Sci. Lab.
(LA-TR-70-10) Avail: NTIS

Possible applications of very low temperatures to the components of large electrical generation and transmission networks in terms of probable evolutions in the next twenty years are reviewed. Taking as an example the French network where generation is in the provinces and a major part of the electrical consumption is concentrated in the Paris region, it is seen that one of the main applications may be that of dc or ac cryo-connections in relation to the improvements that may be made in controlling a.c. losses and in the technology of cryogenic substructure. Other interesting applications may be envisaged for generating stations where the use of superconducting inductors may enlarge the range of unitary power available at the moment. A comparative study of the evolutions in technology and in living matter shows that a choice is necessary to avoid dissipating research efforts towards projects doomed to failure. Author

N71-13047# Harry Diamond Labs., Washington, D.C.
PHYSICAL CONCEPTS IN ULTRASONIC LIGHT DIFFRACTION
Glen Wade and Dominick A. Giglio Jul. 1970 31 p refs
(AD-712975; HDL-TR-1518) Avail: NTIS CSCL 20/6

The physical concepts involved in the diffraction of light by ultrasonic waves are discussed. Also, a specific form of the Laser-Acoustic delay line is discussed, and the general principles of doppler frequency shifts due to motion within the device are presented. Author (TAB)

N71-13048# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Energetics Research Lab.
MEASUREMENT OF SOUND VELOCITY IN A SOLID-GAS MIXTURE Final Report
B. N. Turman Jul. 1970 50 p refs
(AD-712412; ARL-70-0128) Avail: NTIS CSCL 20/1

Velocity of sound through a two-component (solid-gas) medium was measured as a function of solid particle concentration. A method was devised in which phase angle between a sound source signal and microphone signal could be measured as a function of solid particle density in the apparatus. Acoustical theory provided the necessary relationship between phase angle, density, and sound velocity. Sound velocity in the two-component medium was measured over a particle volume fraction range from 0.0001 to 0.5. The possibility of using this technique as a diagnostic instrument is discussed. Author (TAB)

N71-13277# National Physical Lab., Teddington (England). Div. of Quantum Metrology.
THE VACUUM UV SPECTRA FROM MICROWAVE DISCHARGES IN THE INERT GASES
G. H. C. Freeman and J. F. Hinton May 1970 21 p refs
(NPL-Qu-10) Copyright. Avail: NTIS

A description is given of the results of an exploratory experiment which had two objectives: (a) the study of the behavior of the discharge in a prototype lamp and of the impurities which were present, and (b) the selection of one or more lines which are suitable for the evaluation of interferometer components. Author (ESRO)

N71-13278# Norwegian Inst. of Tech., Trondheim. Akustisk Lab.
CORRECTION OF VALUES IN THE MEASUREMENT OF THE SPECTRA OF IMPULSE NOISE
Ctirad Smetana May 1969 43 p refs
(LEA-TR-266) Avail: NTIS

A regular impulse sound level meter will not give correct values when measuring the spectrum of impulse noise due to a time deformation of the signal caused by frequency limited properties within the measuring apparatus. These phenomena are discussed and the exact values are calculated. A trapezoidal substitute signal is proposed to give simple equations for the correct values. Calculated and measured values are compared and correction factor diagrams are presented. Author (ESRO)

N71-13319# National Physical Lab., Teddington (England). Div. of Quantum Metrology.
THE VACUUM UV OPTICAL CONSTANTS OF ALUMINIUM AND OF MAGNESIUM FLUORIDE, AND THE PERFORMANCE OF MAGNESIUM FLUORIDE COATED MIRRORS
G. H. C. Freeman and M. A. Z. Rejman Aug. 1970 26 p refs
(NPL-Qu-12) Copyright. Avail: NTIS

The optical constants of aluminum are fairly well known for lambda less than 900 A and lambda greater than 2200 A so the extinction coefficient and reflectivity curves were calculated for the region between them. Optical constants were also optimized for thin films of magnesium fluoride and magnesium fluoride coated aluminum at normal and 45 deg incidence. All the estimates need checking experimentally. ESRO

N71-13330# Norwegian Inst. of Tech., Trondheim. Akustisk Lab.
APPROXIMATION OF THE CREST FACTOR AND TIME OF DURATION IN IMPULSE SOUND MEASUREMENTS
Ctirad Smetana May 1969 18 p refs
(LEA-TR-265) Avail: NTIS

A method for determining the crest factor and the time duration of an impulse, based on values measured with a precision sound level meter is described. The method uses the impulse and slow dynamical properties of the output meter and gives sufficiently accurate values for practical purposes. Author (ESRO)

N71-13331# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Mathematik und Physik.
FREE AND FORCED VIBRATIONS OF NONLINEAR ISOCHRONIC OSCILLATORS [FREIE UND ERZWUNGENE SCHWINGUNGEN NICHTLINEARER ISOCHRONER SCHWINGER]
Hans Juergen Bangen (Ph.D. Thesis - 12 May 1969) 1970 158 p refs In GERMAN
Avail: NTIS

The free vibrations of a class of conservative oscillators are investigated. The nonlinear differential equations describing the system are transformed into first order equations and solved. By reverse transformation the solution for the original system is given in parameter form. Conditions are investigated for which the free vibration is amplitude-independent (isochronic vibration). Finally, the forced vibrations of anisochronic and isochronic oscillators are examined. ESRO

N71-13338# Naval Weapons Lab., Dahlgren, Va.
PARASITIC RF GAS DISCHARGES AS RECTIFIERS AND INTERFERENCE GENERATORS
Helmut A. Schwab Aug. 1970 43 p refs
(AD-712764; NWL-TR-2470) Avail: NTIS CSCL 20/3

Gas discharges can be maintained in air at atmospheric pressure by rf power. In high intensity fields, for example in the vicinity of radiating antennas, enough power can be coupled into conducting structures to make parasitic discharges possible. They may be started when intermittent contact between conductors is made. It has been found that the discharges are of two distinct types, an rf glow and an rf arc type. If the discharge type alternates with the polarity, highly asymmetric voltage current characteristic result. This allows rf discharges to rectify rf currents. By their nonlinear characteristics they also produce numerous harmonics of the frequency at which they are maintained. Thus parasitic rf discharges can act as broad band interference generators. Author (TAB)

N71-13339# Sussex Univ., Brighton (England). School of Mathematical and Physical Sciences.
THERMAL AND MAGNETIC PROPERTIES OF ADSORBED PHASES OF He-3 AND He-4 AT LOW TEMPERATURES Final Scientific Report, 1 Apr. 1968 - 31 Mar. 1970
Douglas F. Brewer 24 Aug. 1970 11 p refs
(Contract EOOAR-0023-68)
(AD-712416; AFOSR 70-2412TR) Avail: NTIS CSCL 20/13

Further measurements have been made of the adsorbed phases of He at very low temperatures. A notable result is the detection of mean free path effects in Landau quasiparticles, as shown by thermal conductivity measurements in narrow channels. Author (TAB)

N71-13340# Hamburg Univ. (West Germany). Fachbereich Physik.
THE OPTICAL PROPERTIES OF SOLIDIFIED KRYPTON AND XENON FOR PHOTON ENERGIES BETWEEN 30 eV AND 500 eV [DIE OPTISCHEN EIGENSCHAFTEN VON FESTEM KRYPTON UND XENON IM PHOTONENENERGIEBEREICH ZWISCHEN 30 eV UND 500 eV]
Peter Schreiber (Ph.D. Thesis) 1970 73 p refs In GERMAN
Avail: NTIS

The German electron synchrotron is used as a light source in these experiments. Krypton and xenon layers are frozen in a helium cryostat on thin carbon, varnish, or aluminum substrates. The spectral distribution of the penetrated light is measured with a lattice spectrograph and a photomultiplier. The absorption spectra of solidified krypton and xenon appear to be roughly the same as those of the gases. In quantitative comparison big differences are observed and these are explained. ESRO

N71-13384# Houston Univ., Texas. Dept. of Mechanical Engineering.
ON THE TRANSMISSION OF SOUND THROUGH FINITE, CLOSED SHELLS: STATISTICAL ENERGY ANALYSIS, MODAL COUPLING, AND NONRESONANT TRANSMISSION
Larry Dobbs Pope Aug. 1970 187 p refs
(Contract Nonr-4492(01))
(AD-712452; TR-21) Avail: NTIS CSCL 20/1

An investigation of sound transmission into small enclosures considers the effects of acoustically induced coupling between shell modes. Using an integral equation approach, the transmission loss into a small rectangular box is computed and the level of cavity reactance examined. The noise reductions for a closed cylinder and a rectangular parallel-oiped enclosure (with a single flexible panel) sitting in reverberant acoustic fields are computed and experimentally checked. The transmission by resonant and nonresonant shell modes is examined, especially in relation to the statistical energy analysis approach. The nature of the predominance of one type of transmission over the other is considered in relation to shell and cavity configurations and structural damping levels. A technique is given for estimating the predominance of resonant or nonresonant modes as the basis for computations of sound transmission by flat panels and cylindrical shells in reverberant acoustic fields. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N71-12561# Atomic Energy Commission Combined Operations Planning, Oak Ridge, Tenn.
RESOLUTION OF A MULTICOMPONENT CASCADE WITH TWO KEY WEIGHTS AND MULTI-FEEDS AND WITHDRAWALS
A. de la Garza 1 Dec. 1969 15 p refs
(Contract W-7405-eng-26)
(AECOP-330) Avail: NTIS

An extension of the previously reported constant key weight cascades for multicomponent isotope separation is presented. Basic equations are given for the resolution of the productivity of a multicomponent cascade having an upper and a lower section with different key weights. Multi-feeds and withdrawals are also permitted. This cascade should prove useful in investigating the cascade management of minor isotopes, as well as in the separation of a middle component in a single cascade. Author (NSA)

N71-12564# Texas Univ., Austin. Dept. of Physics.
RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY Progress Report
E. C. G. Sudarshan [1969] 24 p refs
(Contract AT(40-1)-3992)

(ORO-3992-17) Avail: NTIS

A summary of research on elementary particle theory is presented. This research covers tachyon theory, scattering of shadow states, duality and the Veneziano amplitude, and Regge theory and Lorentz poles. Also current algebra and chiral symmetry, field theory, and weak and electromagnetic interactions are covered. NSA

N71-12565# Argonne National Lab., Ill.

DAMPING OF COHERENT OSCILLATIONS OF A BEAM IN A STORAGE ELEMENT. 2: SYNCHROTRON EXCITATIONS [O DEMPFIROVANII KOGERENTNYKH KOLEBANII PUCHKA V NAKOPITELE. 2: SINKHROTRONNYE VOZBUZHDENIYA]

Ya. S. Derbenev et al Aug. 1970 16 p refs Transl. into ENGLISH of Akad. Nauk SSSR, Novosibirsk, Preprint No. 318
(ANL-Trans-846) Avail: NTIS

The stability of coherent phase motion of a beam interacting over a chamber segment with ideally matched lines is examined. It is demonstrated that under definite conditions this interaction may lead to so-called memoryless instabilities of synchrotron and radial betatron motion. Damping conditions and expressions for decrements of synchrotron excitations of arbitrary multipole order are derived. Author (NSA)

N71-12598# Argonne National Lab., Ill. Physics Div.

PHYSICS DIVISION SUMMARY REPORT. Annual Review, 1 Apr. 1968 - 31 Mar. 1969

31 Mar. 1969 227 p
(Contract W-31-109-eng-38)
(ANL-7620) Avail: NTIS

Research progress is reported on various aspects of nuclear physics, including: (1) studies of the neutron and of neutron-induced reactions at the CP-5 reactor, (2) neutron and charged-particle reactions at the 4-MeV Dynamitron; (3) charged-particle reactions at the tandem Van de Graaff accelerator, (4) charged-particle reactions at the 60-in. cyclotron, and (5) miscellaneous experiments on gamma- and beta-ray spectroscopy of radioactive sources. NSA

N71-12637# Chicago Univ., Ill. Dept. of Physics.

OPERATORIAL CONSTRUCTION OF MULTIPLE CHARGED PION AMPLITUDES

Jorge F. Willemsen Jul. 1970 22 p refs
(Contract AT(11-1)-264)
(COO-264-552; EFI-70-39) Avail: NTIS

It is shown that taking the 'chiral symmetry' result alpha rho(0) - alpha pi(0) = 1/2 as a hypothesis allows straightforward use of the oscillator formalism to construct 4 pion and 6 pion amplitudes with no tachyon ghosts, and full Regge behavior. An attempt is made to isolate which features of such schemes to generalize the Lovelace amplitude lead to problematic results in the multipion amplitudes which are obtained. Author (NSA)

N71-12638# Oak Ridge National Lab., Tenn. Neutron Physics Div.

NEUTRON ELASTIC AND INELASTIC-SCATTERING CROSS SECTIONS FOR Na IN THE RANGE OF 5.4 TO 8.4 MeV

F. G. Perey and W. E. Kinney Aug. 1970 64 p refs
(Contract W-7405-eng-26)
(ORNL-4518) Avail: NTIS

Numerical values are presented for neutron elastic and inelastic scattering cross sections for Na for incident energies from 5.4 to 8.5 MeV. In this energy region there exists only one previous measurement, at 7 MeV, for the inelastic scattering to the first excited state. This datum point is consistent with the results. Two ENDF/B evaluations for Na are compared with the data. Both evaluations are in fairly good agreement with the integrated elastic cross sections but give poorer agreement for the differential elastic cross sections. For the inelastic scattering cross sections, one of the evaluations does not go above 5 MeV and the other, although it reproduces the cross section for the first excited state fairly well, fails to reproduce the decrease in the inelastic cross sections as a function of energy for the other levels. Author (NSA)

N71-12639# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

MEASUREMENTS OF PREFERRED ORIENTATION IN BERYLLIUM FOILS

Leif V. Singman 1 Apr. 1970 31 p refs
(EGG-1183-1476; L-986) Avail: NTIS

The preferred orientation of 15 Be foil specimens was measured using an X-ray diffractometer and NaI counter. Results of counter measurements and film measurements are tabulated for both qualitative and quantitative interpretations. NSA

N71-12643# California Univ., Berkeley. Lawrence Radiation Lab.

THE SEARCH FOR Z*'s

Gerson Goldhaber Jun. 1970 19 p refs Presented at Intern. Conf. on Hyperon Resonances, Durham, N.C.
(Contract W-7405-eng-48)
(UCRL-19832; CONF-700416-7) Avail: NTIS

In the discussion of the existence and observation of Z resonance three previous works are summarized. These are K(+) + p elastic scattering measurements from 1.4 to 2.3 GeV/c, Regge pole analysis, and K resonance production from the I = 0 K resonance N state. The present status on the Z resonance is discussed. NSA

N71-12644# Oregon Univ., Eugene. Dept. of Physics.

PHASE BAND OF PION(+) PROTON SCATTERING AT 2.5 TO 3.0 GeV/c

David Bridges, Michael J. Moravcsik, and Akihiko Yokosawa (Argonne Natl. Lab., Ill.) [1970] 14 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug. - 4 Sep. 1970 Sponsored in part by AEC Prepared in cooperation with Argonne Natl. Lab., Ill.
(RLO-2041-37; CONF-700806-25) Avail: NTIS

In a partial wave analysis of high-energy scattering data using the phase-band method, the higher partial waves are treated individually as usual, but the lower partial waves are characterized only collectively. The purpose is to determine the higher partial-wave parameters independently of the details of the lower partial waves, which is expected to be possible when the large number of partial waves bring about a substantial decoupling between the various angular momentum states. The method is applied to positive pion proton scattering. The energy, in the absence of adequate data at higher energies, is 2.5 to 3.0 GeV/c, which is far from optimal for the method. Nevertheless, good solutions are found, using considerably fewer parameters than a conventional phase shift analysis would have used for the same number of partial waves. The properties of the solutions are discussed and tests are described which probe the reliability of the method. Author (NSA)

N71-12645# Oregon Univ., Eugene. Dept. of Physics.

SEARCH FOR AN EXCITED PROLATE ROTATIONAL BAND IN Si 28

F. C. P. Huang, E. F. Gibson, and D. K. McDaniels [1970] 31 p refs Sponsored in part by AEC
(RLO-1925-34) Avail: NTIS

Lifetime and branching ratio studies were made in Si-28 utilizing the Al-27(proton, photon) Si-28 reaction. Principal emphasis was given to measurements on levels at 7380, 7416, 7935, 8328, and 9163 keV as possible candidates for the 2(+) state of an excited prolate rotational band. Combining these lifetime and branching ratio results to obtain E2 transition strengths for inter- and intra-band transitions leads to the conclusion that an excited prolate rotational

band is an unlikely possibility. Lifetimes of the 8328-keV and the 9415-keV states were measured as 150(+120 or −50) fsec, and 130(+75 or −50) fsec, respectively. A remeasurement of the lifetime of the 0(+) level at 4975 keV is in substantial agreement with earlier work. Excitation of the interesting 6(+) member of the ground state rotational band was observed at the 2203-keV resonance. Author (NSA)

N71-12646# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Physics.

ENERGY TRANSFER FROM A LARGE AMPLITUDE WHISTLER WAVE TO AN ELECTROSTATIC MODE BY TRAPPED PARTICLE INSTABILITY

G. Schmidt and P. Palmadesso Apr. 1970 10 p refs
(Contract AT(30-1)-3785)
(SIT-3705-11) Avail: NTIS

It was shown that, as a result of the oscillatory nature of trapped particles in whistlers, a large-amplitude whistler mode after a transient cyclotron resonance damping executes strongly damped amplitude oscillations and settles down finally to a state of constant-amplitude whistler mode. Here it is shown that, due to the resonant particles oscillating in the magnetic traps, this mode is subject to an electrostatic trapped-particle instability transferring energy from the transverse mode into a growing longitudinal mode. Dispersion relations are derived and analyzed. NSA

N71-12647# California Univ., Berkeley. Lawrence Radiation Lab.

THE BERKELEY HILAC HEAVIEST ELEMENT RESEARCH PROGRAM

Albert Ghiorso Apr. 1970 62 p refs Presented at Robert A. Welch Found. Confs. on Chem. Res., 13, the Transuranium Elems., Houston, Tex.
(Contract W-7405-eng-48)
(UCRL-18633; CONF-691124-1) Avail: NTIS

Recent work on element 104 at the Berkeley HILAC is described. The alpha-decay properties of the isotopes 257, 259, and 261 of element 104 were established, and the spontaneously-fissioning isotope 258 of element 104 was tentatively characterized. Element 104 was chemically separated by an aqueous method and shown to have properties like hafnium and zirconium as expected. A spontaneous fission activity of element 104 with a 0.3 second half-life as reported by the Dubna group could not be found. NSA

N71-12648# California Univ., Berkeley. Lawrence Radiation Lab.

AN ATTEMPT TO ASSIGN NEUTRON RESONANCE SPINS IN U 235 BY CAPTURE GAMMA RAY MULTIPLICITY MEASUREMENTS

C. D. Bowman, B. L. Berman, and G. D. Sauter 25 May 1970 8 p refs Sponsored in part by AEC
(UCRL-50881) Avail: NTIS

An attempt has been made to assign neutron resonance spins in U-235 by means of the multiplicity of radiative capture gamma rays. The expected grouping of resonances according to spin was not observed, so spin assignments were not possible. Arguments against further attempts at measurement of the spin by indirect techniques are presented. Author (NSA)

N71-12649# Los Alamos Scientific Lab., N.Mex.

COMPTON CURRENT IN PRESENCE OF FIELDS FOR LEMP 1

H. J. Longley 5 Jan. 1970 33 p
(Contract W-7405-eng-36)
(LA-4348) Avail: NTIS

If a Compton electron is produced by a gamma ray of energy E sub gamma in air and with an electromagnetic field (E sub tau, E sub theta, B sub phi) present, it will slow to a stop at an average position (DX,DY). DX is the average distance the electron travels in the direction of the gamma ray and DY is the average distance the electron travels perpendicular to the direction of the gamma ray. This report gives, as a final result, the nonlinear fitted values of the functions DX(E sub gamma, E sub theta, E sub tau, B sub phi) and DY(E sub gamma, E sub theta, E sub tau, B sub phi). The uses of DX and DY in LEMP 1 are discussed. Author (NSA)

N71-12650# Chicago Univ., Ill. Enrico Fermi Inst.

LEVEL DEGENERACY OF THE GENERALISED N-PARTICLE DUAL AMPLITUDE WITH SATELLITES

R. J. Rivers Jul. 1970 16 p refs
(Contract AT(11-1)-264)
(COO-264-551; EFI-70-37) Avail: NTIS

It is shown that the level degeneracy at alpha(s) = n for the general N-pt function with satellites is d sub n approximately exp n-gamma as $n \to \infty$ where gamma = $1 - (1/2k + 1)$ k = 1,2, ... The form of the single loop constructed from such amplitudes is briefly discussed. Author (NSA)

N71-12651# New Mexico State Univ., Las Cruces. Dept. of Physics.

ON THE BINDING ENERGY OF A LAMBDA-PARTICLE IN NUCLEAR MATTER

B. Ram and W. Williams 1970 18 p refs Sponsored by AEC
(TID-25487) Avail: NTIS

The results of a complete calculation of the binding energy of a Lambda-particle in nuclear matter in the method of independent-pair approximation, which systematically takes into account the second- and third-order Born corrections, are presented. It is found that these corrections are small and that the Born-series converges rapidly. A comparison of results with those obtained in other methods based on the Brueckner theory shows that they are identical. Author (NSA)

N71-12652# Syracuse Univ., N.Y. Dept. of Physics.

MULTIVARIABLE EXPANSION OF THE SCATTERING AMPLITUDE INVOLVING AN ARBITRARY NUMBER OF SPINLESS PARTICLES AND CROSSING SYMMETRY FOR PARTIAL WAVES

M. Modjtehedzadeh Feb.1970 45 p refs Sponsored in part by AEC
(NYO-3399-222; SU-1206-222) Avail: NTIS

An infinite number of sum rules for the scattering processes involving any finite number of spinless particles is derived. Each sum rule involves a finite number of partial wave amplitudes from direct and crossed channels. These sum rules are implied by the crossing symmetry of the system and are complete. These sum rules are classified into an independent set, hence a basis for multivariable expansion is obtained. This basis displays the threshold and pseudothreshold zeroes and kinematic singularities of the partial waves. Author (NSA)

N71-12653# California Univ., Berkeley. Lawrence Radiation Lab.

CENTRIFUGAL BARRIER EFFECTS IN MESON DECAYS

C. Quigg and F. von Hippel May 1970 15 p refs Presented at the Exptl. Meson Spectry. Conf., Philadelphia
(Contract W-7405-eng-48)
(UCRL-19826; CONF-700525-6) Avail: NTIS

Centrifugal barrier penetration factors are used to investigate the kinematics of meson decays in order to probe hadron spectroscopy. All dynamical effects are neglected. An attempt is made to provide a framework in which the dynamics may be isolated and studied experimentally. NSA

N71-12654# Syracuse Univ., N.Y. Dept. of Physics.

NO-GO THEOREMS FOR DUAL MODELS

A. P. Balachandran, L. N. Chang (Chicago Univ.) and P. H. Frampton (Chicago Univ.) Jul. 1970 14 p refs Prepared in cooperation with Chicago Univ.

(Contract AT(11-1)-264)
(COO-264-554; EFI-70-41) Avail: NTIS

Two no-go theorems relevant to the construction of positive-intercept dual models are stated and proved. The theorems explain why one cannot develop a physically sensible model by a simple multiplicative modification of the usual (negative-intercept) N particle dual amplitude. Author (NSA)

N71-12655# California Inst. of Tech., Pasadena.
EXPERIMENTS ON PARITY NONCONSERVATION IN NUCLEAR FORCES
J. C. Vanderleeden and F. Boehm 1969 24 p refs Presented at the Conf. on Nucl. and Elementary Particle Phys., Brighton, Engl., 24–26 Sep. 1969
(Contract AT(04-3)-63)
(CALT-63-121; CONF-690958-1) Avail: NTIS

The circular polarization of gamma rays from unpolarized sources of Hf-181 and Yb-175 was measured, using a Compton polarimeter and a current integrating Ge(Li) detector system. The results are P gamma = (−3.8 + or − 1.3) × 0.000001 for the 482 keV transition in Ta-181 and P gamma = (+6.2 + or − 0.8) × 0.00001 for the 396 keV transition in Lu-175. Author (NSA)

N71-12656# California Univ., Santa Cruz.
TIME REVERSAL INVARIANCE IN THE ELECTROMAGNETIC INTERACTION
Clemens A. Heusch [1970] 35 p refs Presented at the 5th Intern. Conf. on Electromagnetic Interactions, Moriond, France, 9–21 Mar. 1970 Prepared in cooperation with Calif. Inst. of Tech., Pasadena, Calif.
(Contract AT(11-1)-68)
(CALT-68-264; CONF-700325-1) Avail: NTIS

Time reversal invariance violation in the electromagnetic interactions of hadrons is considered. The formulation of time reversal and some possible tests of T invariance are considered. Various previous experiments on hadron electromagnetic interactions are discussed. NSA

N71-12666# Pennsylvania Univ., Philadelphia. Dept. of Physics.
NONLINEAR EFFECTS IN QUANTUM ELECTRODYNAMICS: PHOTON PROPAGATION AND PHOTON SPLITTING IN AN EXTERNAL FIELD
Z. Bialynicka-Birula and I. Bialynicka-Birula Jun. 1970 21 p refs
(Contract AT(30-1)-3829)
(NYO-3829-54) Avail: NTIS

The effective nonlinear Lagrangian derived by Heisenberg and Euler is used to describe the propagation of photons in slowly varying but otherwise arbitrary electromagnetic fields. The group and the phase velocities for both propagation modes are calculated and it is shown that the propagation is always causal. The photon splitting processes are also studied and it is shown that they do not play any significant role even in very strong magnetic fields surrounding neutron stars. Author (NSA)

N71-12667# Sandia Corp., Albuquerque, N.Mex. Aerospace Nuclear Safety Dept.
AEROSPACE-NUCLEAR SAFETY PROGRAM Quarterly Report, 1 Apr. –30 Jun. 1970
A. J. Clark, Jr. and R. G. Illing, comp. Jul. 1970 61 p refs Sponsored by AEC
(SC-PR-70-435) Avail: NTIS

Research and development devoted to radioisotope safety support involving SNAP-27, TRANSIT, PIONEER/VIKING, ISOTOPE BRAYTON Heat Source and Dart minithruster are reported. Activities in safety technology research were directed toward advanced fuels safety, recovery and tracking methods, flight tests, reentry, models of abort, and computer codes. NSA

N71-12668# Case Western Reserve Univ., Cleveland, Ohio.
RESEARCH PROGRAM IN HIGH ENERGY ACCELERATOR PHYSICS AND LOW LEVEL COUNTING ELEMENTARY PARTICLE PHYSICS Technical Report, 1 Oct. 1969 – 30 Sep. 1970
William R. Frisken, Thomas L. Jenkins, Charles R. Sullivan, William M. Smith, and Alan G. Strelzoff Jun. 1970 23 p refs
(Contract AT(11-1)-1749)
(COO-1749-18) Avail: NTIS

Research on pion(−) + p charge exchange, proton stability, and double beta decay is summarized. A list of publications is included. NSA

N71-12676# California Univ., Berkeley. Lawrence Radiation Lab.
DUAL RESONANCE MODELS FOR VECTOR CURRENTS
J. H. Weis 6 May 1970 75 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev
(Contract W-7405-eng-48)
(UCRL-19780; CONF-700806-27) Avail: NTIS

Recent work on dual Reggeized resonance models for vector currents is discussed. The properties vector current amplitudes in such models are expected to possess are first described in some detail: i.e., (1) factorization, (2) divergence conditions, and (3) good large-q2 behavior. Presently existing models fall into two classes: factorizable models that emphasize (1) and (2) at the expense of (3), and phenomenological models that emphasize (2) at the expense of (1) and (3). These models are discussed and a new phenomenological model is proposed that incorporates exponentially falling form factors, a property it is believed dual resonance models should possess. The partial successes described is found a source of optimism for an eventual complete solution of the problem. Author (NSA)

N71-12677# Chicago Univ., Ill. Enrico Fermi Inst.
THE ETA-MESON 3 PION DECAY WITH SUSSKIND'S MODEL
Yoshio Miyatake Jul. 1970 17 p refs
(Contract AT(11-1)-264)
(COO-264-553; EFI-70-40) Avail: NTIS

The eta meson yields pion(+) + pion(−) + pion(0) decay amplitude is calculated with Susskind's formula. The result is not good if all multiperipheral tree-diagrams are taken, although some of them show very good agreement with experiment. Charge symmetry is satisfied. An interpretation is given to Susskind's formula by analogy with the two-fluid model in superconductivity. Author (NSA)

N71-12678# Illinois Univ., Urbana. Dept. of Physics.
BACKWARD f SUP 0 PRODUCTION IN PION(+) DEUTERON YIELDS PROTON PROTON PION(+) PION(−) AT 4.19 GeV/c
B. Eisenstein and H. Gordon Jul. 1970 12 p refs Sponsored by AEC
(COO-1195-194) Avail: NTIS

Backward f(0) production was observed in the reaction pion(+) deuteron yields proton proton pion(+) pion(−) at 4.19 GeV/c. The f(0) decay angular distribution is consistent with production by elementary nucleon exchange in the u-channel. No structure is seen, within the limit of the statistics, in d sigma/du. Author (NSA)

N71-12700# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
DEEXCITATION PROCESSES IN NUCLEAR REACTIONS Progress Report, May 1969 – Apr. 1970
Norbert T. Porile May 1970 39 p refs
(Contract AT(11-1)-1505)
(COO-1505-42) Avail: NTIS

Research progress is reported on the differential range of the reaction mechanism of alpha reactions at 20 to 42 MeV and helium 3 reactions at 32 MeV in copper 65, the energy dependence

of recoil properties of products from proton reactions at 0.45 to 11.5 GeV in uranium 238, and construction of Van de Graaff accelerator facilities for nuclear chemistry research. NSA

N71-12729# ARO, Inc., Arnold Air Force Station, Tenn.
TECHNIQUE FOR THE ANALYSIS AND COMPUTERIZED DATA REDUCTION OF TIME-OF-FLIGHT DISTRIBUTIONS OF FREE-JET EXPANSIONS Final Technical Report, Jan. – Oct. 1969
J. A. Benek, M. R. Busby, and H. M. Powell AEDC Oct. 1970 31 p refs
(Contract F40600-71-C-0002)
(AD-712372; AEDC-TR-70-84) Avail: NTIS CSCL 20/4

A velocity distribution function for a molecular beam formed from an aerodynamically accelerated source is developed from the Maxwell-Boltzmann distribution function for an effusive source. The distribution function is presented in a form compatible with the time-of-flight measurement technique for the experimental determination of such distributions. The expressions for several parameters of general interest, such as static temperature, speed ratio, energy, and velocity, are also presented. A description of a computerized data reduction technique for time-of-flight measurements is given. In addition, the effect of shutter functions and time delays in the accurate measurement of velocity distributions are discussed. Author (TAB)

N71-12731# Oak Ridge National Lab., Tenn.
SHIELDING BENCHMARK PROBLEMS
A. E. Profio, ed. Aug. 1970 44 p refs
(Contract W-7405-eng-26)
(ORNL-RSIC-25-Suppl-1; ANS-SD-9-Suppl-1) Avail: NTIS

The Benchmark Problems Group of the American Nuclear Society Shielding Standards Subcommittee (ANS-6) has selected several benchmark problems for testing computational methods of radiation transport. Problems are described and solution data are presented. It is anticipated that publication of these problems will serve to focus attention so that careful work will produce solutions which are representative of the state-of-the-art. The problems will also serve to specify standard configurations so that meaningful comparisons can be made between different calculational methods and between experimental and calculational results. Supplement 1 provides an additional solution to a problem issued previously (neutron spectrum in graphite) and presents a new problem (nucleon-meson cascade in iron). Author (NSA)

N71-12732# California Univ., Livermore. Lawrence Radiation Lab.
AN ANALYSIS OF A PROPOSED n-n SCATTERING EXPERIMENT
W. C. Dickinson, E. M. Lent, and C. D. Bowman 1 Apr. 1970 88 p refs
(UCRL-50848) Avail: NTIS

The various experimental parameters affecting a proposed measurement of the neutron–neutron scattering cross-section in a high-flux pulsed nuclear reactor are investigated. In calculating neutron production rates, one assumes first a velocity-dependent isotropic neutron distribution in the reactor cavity and, second, a single-velocity anisotropic distribution. Also neutron production rates are calculated for neutron scattering from a calibration gas that could be placed in the cavity. Expressions are given for the distribution of neutron arrival times at the n-n detector. The effect of experimental geometry on n-n counting rate is considered, and also an optimum geometry for the experiment is proposed. A fairly accurate expression is given for calculating the number of n-n scattered neutrons counted per reaction pulse, along with an error analysis of the experiment. Author (NSA)

N71-12739# California Univ., Berkeley. Lawrence Radiation Lab.
RADIATION-INDUCED FREE RADICAL DESTRUCTION
Paul Karl Horan (Ph.D. Thesis) Jun. 1970 95 p refs
(Contract W-7405-eng-48)
(UCRL-19849) Avail: NTIS

Free radical production and destruction kinetics were studied. It is shown that destruction is a physical fact and various mechanisms for this destruction are discussed. An attempt was made to identify the mechanism responsible by determining its activation energy. It is demonstrated that more than one process exists and that the electron-hole mechanism is quite possibly one of the processes involved. Evidence is presented that thermally produced electron-holes react with radioinduced organic free radicals. NSA

N71-12740# Syracuse Univ., N.Y. Dept. of Physics.
RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY Progress Report, Period Ending 31 Aug. 1970
31 Aug. 1970 31 p refs
(Contract AT(30-1)-3399)
(NYO-3399-226; SU-1206-226) Avail: NTIS

Research on elementary particle theory for the period ending August 31, 1970 at Syracuse University is reported. This research covers dual models, local duality, phenomenology based on Regge poles and cuts, deep inelastic scattering, two-variable expansion of scattering amplitudes and constraints on partial waves, chiral symmetry, and unified description of weak and electromagnetic interactions. A list of publications is included. NSA

N71-12741# Iowa State Univ. of Science and Technology, Ames.
PHOTON MONOCHROMATOR USING COMPTON-SCATTERED GAMMA RAYS
J. E. Hall, R. G. Struss, and D. J. Zaffarano Jul. 1970 55 p refs
(Contract W-7405-eng-82)
(IS-2335) Avail: NTIS

A facility has been developed which uses Compton-scattered gamma rays as a variable energy source for photonuclear experiments below 8.2 MeV. A collimated beam of neutron-capture gamma rays of maximum energy 8996 keV was produced by positioning a 1 kg plate of nickel in the tangential tube of the research reactor. The energy of these gamma rays was varied by Compton scattering from a curved plate. In order to ensure that the (n,gamma) source, the scattering plate, and the photonuclear target all lie on the same arc of a circle for each scattering angle, the curvature of the scattering plate was made easily variable. The efficiency of various materials for use as the scattering plate has been calculated. Characteristics of the scattered gamma ray beam at the target position are presented for the case of an aluminum scattering plate. Author (NSA)

N71-12742# Pennsylvania Univ., Philadelphia. Dept. of Physics.
THEORETICAL AND EXPERIMENTAL RESEARCH ACTIVITIES IN HIGH ENERGY PHYSICS Progress Report, Sep. 1969 – May 1970
May 1970 61 p refs
(Contract AT(30-1)-2171)
(NYO-2171-310) Avail: NTIS

Research in high-energy physics at the University of Pennsylvania during the period from September 1969 to May 1970 is reported. The theoretical research covers elementary particle physics and nuclear structure, while the experimental research includes weak and strong interactions. The supporting facilities are also described. A list of articles published during this period is included. NSA

N71-12743# California Univ., Riverside.
[HIGH ENERGY PHYSICS] Annual Report
A. Kernan and R. T. Poe May 1970 19 p refs
(Contract AT(04-3)-34)
(UCR-34-P-107-104) Avail: NTIS

A brief summary of research on positive pion proton and negative kaon proton interactions, high energy phenomenology, and diffraction dissociation in negative pion deuteron interactions is presented. NSA

N71-12744# Oak Ridge National Lab., Tenn.
CALCULATED RESIDUAL RADIATION LEVELS FOR SOME ELEMENTS USED IN CYCLOTRON STRUCTURES
C. B. Fulmer and G. Kindred Aug. 1970 28 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2834) Avail: NTIS

Residual radiation levels were calculated for beams of protons, deuterons, helium 3, and alpha particles incident on targets of carbon, aluminum, iron, copper, and tantalum. All significant radioactivities were taken into account. Excitation functions, based on experimental data, were used. The calculations were for a range of incident energies and for bombardment times of 8 hours to 1 month and cooling times of 1 hour to 1 week. Author (NSA)

N71-12773# Rome Univ. (Italy). Inst. of Physics.
REALIZATION OF CHIRAL SYMMETRY IN THE MESON STATES THROUGH SU(4) DIRECT PRODUCT O(3)
C. Boldrighini, F. Buccella (CERN), E. Celeghini (Florence Univ.), E. Sorace (Florence Univ.), and L. Triolo 6 Apr. 1970 12 p refs *Its* Nota Interna No. 262
Avail: NTIS

A saturation scheme is proposed for the equations describing the classification of meson states, within the lower states, belonging to the 15 L = 0.1 representations of SU(4) direct product O(3). The introduction of two mixing parameters enables the derivation of the chiral couplings of these particles to be in reasonable agreement with experiments. In particular the helicity properties of A and B decays come out correctly. ESRO

N71-12805# Washington Univ., Seattle. Dept. of Physics.
SPIN-ISOSPIN FORMALISM FOR MULTIPLE SCATTERING OF PIONS
N. W. Dean and J. L. Friar 1969 30 p refs
(Contract AT(45-1)-1388)
(RLO-1388-570) Avail: NTIS

The scattering of pions by composite particles is considered, including effects of spin and isospin, using the Glauber formalism. The spin-isospin terms produce the group SU(4) in the scattering amplitude, which must be treated in the supermultiplet basis. Expressions are derived from pion scattering by light nuclei in terms of the pion-nucleon amplitudes, considering in particular the deuteron, He-3 and He-4. An application is also made to multiple scattering in the quark model. Author (NSA)

N71-12806# Los Alamos Scientific Lab., N.Mex.
CALCULATION OF SINGLE-PARTICLE LEVELS IN A DEFORMED DIFFUSE WELL
G. P. Ford, D. C. Hoffman, and E. Rost Nov. 1969 109 p refs
(Contract W-7405-eng-36)
(LA-4329; UC-34) Avail: NTIS

Energy levels for spherical and deformed Woods-Saxon potentials with a Thomas-type spin-orbit coupling were calculated for prolate deformations at intervals of 0.05 in beta up to beta = 0.5. Level diagrams for neutrons are presented in the 139 < or = to A < or = to 191 and 219 < or = to A < or = to 313 regions. Level diagrams for protons are given for all odd Z's in the regions 57 < or = to Z < or < = to 77 and 85 < or = to Z < or = to 109, for the same masses. Some additional proton cases were calculated for constant A to show the Coulomb and symmetry-energy dependence. The potential parameters, r sub 0, V sub 0, alpha, and lambda, were chosen to give the best agreement with the known ground-state level assignments in these regions. Energies were obtained as eigenvalues of matrices representing the Hamiltonian in terms of truncated sets of spherical basis functions. Author (NSA)

N71-12807# Pennsylvania Univ., Philadelphia. Dept. of Physics.
CURRENT COMMUTATOR DERIVATION OF MASS DIFFERENCE RELATIONS
Ashok Goyal, Ling Fong Li, and Gino Segre [1970] 21 p refs
Supported in part by AEC
(NYO-2171-315) Avail: NTIS

The consequences of the vanishing of certain double commutators are investigated to examine the consistency of SU(3) × SU(3) breaking models. Also the contribution of Delta I = 2 mass differences of isospin violating terms other than the electromagnetic interactions, in the Hamiltonian are calculated. NSA

N71-12808# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
Pu-239 UNRESOLVED RESONANCE DATA FOR ENDF/B VERSION 2
J. T. Hitchcock and B. A. Hutchins Apr. 1970 30 p refs
(Contract AT(04-3)-189)
(GEAP-13591) Avail: NTIS

An evaluation of the Pu-239 neutron cross section data in the unresolved resonance region (300 eV to 25 keV) has been completed and a set of recommended Breit–Wigner statistical parameters sent to the National Neutron Cross Section Center for the ENDF/B nuclear data file, Version 2. This evaluation was undertaken to include recent, high-resolution fission cross section and alpha measurements below 25 keV. The s-wave parameters chosen, together with a small p-wave contribution, produce cross sections which agree well with both the measured sigma(n,f) and alpha values. Author (NSA)

N71-12811# Iowa State Univ. of Science and Technology, Ames. Dept. of Physics.
GAMMA RAY DECAY SCHEMES FOR Se-142, Cs-142, Ba-142, La-142
Jon Thorsten Larsen (Ph.D. Thesis) Feb. 1970 140 p refs
(Contract W-7405-eng-82)
(IS-T-352) Avail: NTIS

Measurements are reported for gamma energies and intensities present in the decays of the four nuclei XE-142, Cs-142, Ba-142, and La-142. These nuclei are all members of the isobaric decay chain beginning with Xe-142, which was made available by use of an online isotope separator system developed for the study of gaseous fission products. Partial energy level schemes were constructed for Cs-142, Ba-142, La-142, and Ce-142 with the aid of Ge(Li)–Ge(Li) coincidence data. Some spin–parity assignments were made for levels in Ba-142 and Ce-142; comparative half-lives were calculated for the decays of Ba-142 and La-142. An attempt is made to interpret some of the energy levels in the even–even Ba-142 and Ce-142 nuclei; these nuclei appear to exhibit vibrational-like excitations. Author (NSA)

N71-12812# Rochester Univ., N.Y. Dept. of Chemistry.
STUDIES OF NUCLEAR FISSION, LOW-ENERGY NUCLEAR REACTIONS AND TRANSURANIC NUCLEI Progress Report, 1 Jun. 1969 – 1 Jun. 1970
John R. Huizenga Jun. 1970 38 p refs
Contract AT(30-1)-3938)
(NYO-3938-3) Avail: NTIS

Energy levels from plutonium-242 (alpha,t) and plutonium-242 (He-3d) reactions and spectroscopic factors for americium-242 are discussed as well as neutron fission at 0.5 to 1.2 MeV and angular distributions of fragments from plutonium-242; energy levels of uranium-235 with calculation of spectroscopic factors using Coriolis matrix elements; photofission at 5.3 to 6.8 MeV and angular distributions of fragments from uranium-236; energy levels from uranium-238 (He-3,alpha) reactions with uranium-237; and helium-3 reactions (He-3,alpha) at 30 MeV and angular distribution for uranium-238. (NSA)

N71-12813# Los Alamos Scientific Lab., N.Mex.
FISSION CROSS SECTION OF Np-237 FROM POMMARD
W. K. Brown, D. R. Dixon, and D. M. Drake 30 Mar. 1970 24 p refs
Contract W-7405-eng-36)
(LA-4372) Avail: NTIS

The Np-237(n,f) cross section was measured from 32 eV to 2.2 keV and from 100 keV to 2.8 MeV. Energies of neutrons from the underground nuclear explosion Pommard were determined by time of flight from the source to the target foil located near the surface. Signals produced by fission fragments in solid-state detectors were recorded photographically. The U-235(n,f) and Li-6(n,alpha) reactions were used to measure the neutron flux. Grouped subthreshold resonances were observed. Above threshold the cross section reached a maximum of about 1.7 b in the vicinity of 2.2 MeV. Author (NSA)

N71-12825# Forskningsradens Lab., Studsvik (Sweden).
THE K-CONVERSION COEFFICIENT OF THE 897-keV TRANSITION IN Pb-207
B. Ahlesten and A. Baecklin 1970 7 p refs Supported by Swed. At. Res. Council
(NP-18288; LF-26) Avail: AEC Depository Libraries

The K-conversion intensity and gamma intensity of the 897 keV transition in Pb-207 were measured, yielding a K-conversion coefficient of 0.019 + or − 0.003, which is compatible with multipolarity M1 + <25% E2. Author (NSA)

N71-12827# California Inst. of Tech., Pasadena.
TEST OF THE DELTA S = DELTA Q RULE IN NEUTRAL KAON SUB e3
F. J. Sciulli, J. D. Gallivan, D. M. Binnie, R. Gomez, M. L. Mallary et al 1970 30 p refs Presented at 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug.−4 Sep. 1970
(Contract AT(11-1)-68)
(CALT-68-251; CONF-700806-24) Avail: NTIS

The time distribution of the positive pion electron neutrino and negative pion positron neutrino modes from initial neutral kaons in a spark chamber experiment performed at the LRL Bevatron was measured. From 1079 events in the fiducial volume, between 0.2 and 7 neutral kaon sub s lifetimes, it is found that ReX = −0.069 + or − 0.036, ImX = +0.108 (+0.092 −0.074). This result is within two standard deviations of X = 0, and therefore consistent with it (relative probability = 0.25). It is, on the other hand, more than four standard deviations from the existing world average (+0.14, −0.13), and therefore inconsistent with this value (relative probability less than 3.3 × 0.0001). Author (NSA)

N71-12828# Illinois Univ., Urbana. Dept. of Physics.
THREE BODY DECAYS OF NEUTRAL K MESONS
A. Abashian, M. Graham, L. Jones, P. Mantsch, R. Orr et al Jun. 1970 14 p ref Presented at 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug.−4 Sep. 1970 Sponsored in part by AEC
(COO-1195-187; CONF-700806-16) Avail: NTIS

Decays of neutral K mesons produced through the associated production reaction negative pion + proton yields neutral Lambda hyperon + neutral kaon were observed in a magnetic spectrometer spark chamber system at the Argonne ZGS. By observing the distribution in time of the neutral kaon decays into the kaon sub e3, kaon sub mu3 and kaon sub pi3 modes, we have been able to test the Delta S = Delta Q rule and to look for CP violation in these decay modes. Preliminary results are consistent with no Delta S = Delta Q amplitude and with no amplitude for neutral kaon sub s yields positive pion negative pion neutral pion. Author (NSA)

N71-12831# Iowa State Univ. of Science and Technology, Ames.
PHOTOFISSION OF U 235 and U 238 USING A COMPTON SCATTERING MONOCHROMATOR
James Edison Hall (Ph.D. Thesis) May 1970 92 p refs
(Contract W-7405-eng-82)
(IS-T-375) Avail: NTIS

The photofission yields from U-235 and U-238 were measured in the energy range 4.7 to 8.0 MeV using a surface-barrier semiconductor detector. Cf-252 was used to calibrate the response of the fission fragment detection system. Structure was evident in the photofission yield from U-238, but not from U-235. Conclusions about the fission cross sections of these nuclides can be drawn from the yield curves. These are discussed on the basis of Bohr's theory of fission channels and Strutinsky's double-humped potential. In order to conduct these photofission experiments, it was necessary to design, construct, and calibrate a variable energy gamma source. The source was a beam of neutron-capture gamma rays of maximum energy 8996 keV whose energy was varied by Compton scattering from a curved aluminum plate. The intensity of the scattered 8996 keV line incident on the fission target (2.00 × 0.75 in.) was 100,000 per sec at a scattering angle of 13.45 degrees (6067 keV). Author (NSA)

N71-12832# Oak Ridge National Lab., Tenn. Neutron Physics Div.
NEUTRON ELASTIC AND INELASTIC-SCATTERING CROSS SECTIONS FOR Fe 56 IN THE ENERGY RANGE 4.19 TO 8.56 MeV
W. E. Kinney and F. G. Perey Jun. 1970 143 p refs
(Contract W-7405-eng-26)
(ORNL-4515) Avail: NTIS

Numerical values of neutron elastic- and inelastic cross sections to levels in Fe-56 per atom of natural iron for incident neutron energies from 4.19 to 8.56 MeV are presented. The results compare favorably with the results of others. Also, three sets of evaluated iron cross sections were compared with experimental data and it was found that the total scattering cross sections are in fair agreement with the experimental data, but the differential elastic-scattering cross sections are not a good representation of the data beyond the first minimum. Author (NSA)

N71-12833# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry.
NUCLEAR CHEMISTRY RESEARCH OF HIGH-ENERGY NUCLEAR REACTIONS AT CARNEGIE-MELLON UNIVERSITY Annual Progress Report, 1969−1970
1 Jun. 1970 90 p refs
(Contract AT(30-1)-2897)
(NYO-2897-41) Avail: NTIS

The cross sections of (p,2p), (p,pn), and (p,2n) reactions at 300 MeV on the separated isotopes of tellurium were determined. The total (p,pn) cross sections, for those cases in which it was only possible to measure one of the isomeric states in the product, was calculated by assuming that the direct knock-out mechanism was predominant. Both the total (p,pn) cross sections and the (p,2n) cross sections are directly proportional to the neutron skin thickness. This is consistent with the assumption that these reactions take place by direct knock-out processes in the diffuse or peripheral region of the nucleus. The tellurium (p,2p) reactions were observed to be inversely proportional to the neutron skin thickness. Author

N71-12842# Forskningsradens Lab., Studsvik (Sweden).
THERMAL NEUTRON CAPTURE IN NATURAL CALCIUM
S. Boreving (Chalmers Univ. of Technol.) and E. Falkstroem (Chalmers Univ. of Technol.) 1968 26 p refs
(NP-18290; LF-22) Avail: AEC Depository Libraries

Thermal neutron capture gamma rays from natural calcium were studied by means of Ge(Li) spectrometers. Energies and intensities of the gamma rays from the product nucleus Ca-41 are reported. The Q-value of the Ca-40(n,gamma)Ca-41 reaction was determined as 8363.1 + or − 0.5 keV. A decay scheme of the Ca-41 isotope is proposed, and a comparison is made between results from the Ca-40(d,p)Ca-41 and the Ca-40(n,gamma)Ca-41 reactions. Author (NSA)

N71-12843# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
FIXING OF THE INDEFINITENESS OF THE RESULTS IN MULTICHANNEL SCATTERING THEORY
B. N. Zakharev and V. L. Shmonin 1970 11 p refs In RUSSIAN
(JINR-P4-5149) Avail: AEC Depository Libraries

The method of solving multichannel scattering problems is proposed which permits one to give the strict two-sided estimation of a possible error for a computed value of any observable magnitude. Author (NSA)

N71-12844# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
INVESTIGATION OF THE REGULARITIES OF THE PRODUCTION OF SPONTANEOUSLY FISSIONABLE ISOTOPE OF ELEMENT 105
G. N. Flerov, Yu. Ts. Oganesyan, Yu. V. Lobanov, Yu. A. Lazarev, V. I. Kuznetsov et al 1970 13 p refs In RUSSIAN
(JINR-P7-5108) Avail: AEC Depository Libraries

Excitation functions of spontaneously fissionable isotopes of elements 102 and 105 were studied in bombarding U-235 and Am-243 by accelerated Ne-22 ions. It is shown that previously observed spontaneously fissionable element 105 isotope with T sub 1/2 = 2.2 + or - 0.5 s has an excitation function with a maximum at the ion energy of 117 MeV and width on the half-height of 8 MeV. It follows from the totality of experimental data that this emitter is produced in the complete fusion reaction with the posterior evaporation of neutrons from the excited compound nucleus of 105-265. Isotope yield, determined according to the branch of spontaneous fission, in the maximum of the excitation function corresponds to the (5 + or - 1.5) 10 to the - 34th power sq cm cross section. Author (NSA)

N71-12846# Idaho Nuclear Corp., Idaho Falls.
CATALOGUE OF SEMICONDUCTOR ALPHA-PARTICLE SPECTRA
R. N. Chanda and R. A. Deal Mar. 1970 159 p refs
(Contract AT(10-1)-1230)
(IN-1261) Avail: NTIS

A compilation of alpha-particle spectra obtained with silicon surface-barrier detectors is presented. Spectra are presented of 35 nuclides ranging from Z = 83 to 89. Included are nuclides of both the natural decay chains and a number of the most frequently encountered artificially produced nuclides. A thin source preparation method, described was used. In order that these spectra be useful for analytical purposes, all spectra were recorded under a standard set of conditions that can be readily reproduced in other laboratories. Conditions such as detector size, resolution, geometry, sample size, and gain scale were standardized. The spectra are presented in graphical as well as digital form. In addition, the electronics, use of detectors, and sample preparation techniques are described in detail. Appendices are included listing nuclides according to Z, A, and alpha-particle energy, a table of specific activities, the natural radioactive series and a range-energy curve. Author (NSA)

N71-12847# California Inst. of Tech., Pasadena. Norman Bridge Lab. of Physics.
NUCLEAR SPECTROSCOPY AND X-RAY PROGRAM Annual Report, 1 Oct. 1969 -30 Sep. 1970
Felix Boehm 20 Apr. 1970 24 p refs
(Contract AT(04-3)-63)
(CALT-63-143; AR-16) Avail: NTIS

Progress in nuclear research is reported. The scope of the program is the study of nuclear structure and the properties of the nuclear force, in particular its symmetries, using the tools of nuclear spectroscopy. NSA

N71-12848# Washington Univ., Seattle.
SPONTANEOUS FISSION ISOMERISM IN URANIUM ISOTOPES
K. L. Wolf, R. Vandenbosch, P. A. Russo, M. K. Mehta, and C. R. Rudy Dec. 1969 18 p refs Sponsored by AEC
(RLO-1388-114) Avail: NTIS

A search for spontaneous fission isomerism in uranium and neptunium isotopes has resulted in the identification of a new isomer in U-238 with a half-life of 195 + or - 30 nsec. A measurement of the half-life of previously reported U-236M gives a value of 105 + or - 20 nsec. Excitation functions were determined for the production of the spontaneous fission isomers of U-236 and U-238 by deuteron bombardment of U-236 and U-238 targets. Isomer ratios were also estimated. The low values of the isomer ratios and the failure to observe delayed fission in lighter uranium isotopes and in neptunium isotopes suggests that gamma decay may be the dominant mode of decay of shape isomers in this mass region. Author (NSA)

N71-12849# Illinois Univ., Urbana. Dept. of Physics.
FEATURES OF THE K(+) d REACTION AT 3.8 GeV/c
B. Eisenstein, H. Gordon, J. Kim, D. Marshall, W. Moniger, et al Jun. 1970 14 p refs Presented at 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug.-4 Sep. 1970 Sponsored in part by AEC
(COO-1195-186; CONF-700806-18) Avail: NTIS

A study is reported of 761 events of the reaction K(+) d yields K(+) pion(-) pion(+) d at 3.8 GeV/c. This reaction shows strong production of neutral Kaon* (890) and also of the d*(++) effect. The K(+) pion(-) pion(+) mass spectrum displays clear evidence for an enhancement at 1.30 GeV/c squared with a full width at half maximum of 54 MeV/c squared. This narrow Q enhancement is superimposed on a much broader background which peaks at about 1.15 GeV/c squared. The narrow Q is primarily associated with events in which the d*(++) effect is not present. The broad background is described well by a Reggeized pion exchange model applied to the reaction K(+) d yields K*(0) pion(+) d. The narrow Q probably has J sup P = 1(+). Also Q production seen in the final states K(0) pion(+) pion(0) d and K(+) pion(+) pion(-) pn is briefly described. Preliminary results of a study of the reaction K(+) d yields K(0) pp are given. The differential cross section is compared to a rho meson, rho' meson A sub 2 exchange model. Author (NSA)

N71-12850# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
TECHNIQUE OF ANTINEUTRINO MEASUREMENT OF NEUTRON TIME-OF-FLIGHT SPECTROMETER
Yu. V. Ryadov and N. Chikov 1970 19 p refs In RUSSIAN
(JINR-P3-5119) Avail: AEC Depository Libraries

A large liquid cadmium-loaded scintillation detector, having the efficiency to the fission neutrons of anout 90%, is used for measurements of the yield (antineutrino) of an average number of prompt neutrons per fission act. Author (NSA)

N71-12851# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
ANALYSIS OF THE TOTAL RADIATION WIDTHS OF THE NUCLEAR NEUTRON RESONANCES
H. Malecki, L. B. Pikelner, I. M. Salmatin, and E. I. Sharapov 1970 22 p refs In RUSSIAN Presented at the 2d Intern. Conf. on Nucl. Data on Reactors, Helsinki, Jun. 1970
(JINR-P3-4929; Conf-700605-1) Avail: AEC Depository Libraries

For a large number of nuclei in the mass range 60 to 247 a comparison is made of the experimental total radiation widths with theory. An empirical dependence is suggested for the radiation widths. Author (NSA)

N71-12852# American Nuclear Society, Hinsdale, Ill.
PROCEEDINGS OF THE TUTORIAL SESSION ON NUCLEAR MODELS
Erich Vogt, Robert Vandenbosch, and V. A. Madsen Mar. 1970

64 p refs Conf. held at Seattle, 15 Jun. 1969
(ANS-RPD-2; CONF-690609-25; CONF-690609-26; CONF-690609-27) Avail: NTIS

Work in the use of nuclear models for describing and analyzing nuclear structure is given. Information is given in lecture form and contains an educational summary, fission barrier minimums, and the problems of inelastic scattering. E.H.W.

N71-12853# California Univ., Berkeley. Lawrence Radiation Lab.
LAMBDA (1520) REVISITED
Robert D. Tripp May 1970 18 p refs Presented at Intern. Conf. on Hyperon Resonances, Durham, N.C., 24–25 Apr. 1970
(Contract W-7405-eng-48)
(UCRL-19765) Avail: NTIS

The experimental data in the vicinity of the Lambda hyperon (1520) are reviewed. This review includes the production, decay, and branching ratio for this resonance. The experimental phenomena for K(−) + p interactions near this resonance are also discussed. NSA

N71-12854# California Univ., Berkeley. Lawrence Radiation Lab.
ON-LINE CALCULATION OF BEAM TRANSPORT SYSTEMS TO FIRST AND SECOND ORDER
John S. Colonias, Arthur C. Paul Apr. 1970 23 p refs Presented at 3d Intern. Conf. on Magnet Technol., Hamburg, 18–23 May 1970
(Contract W-7405-eng-48)
(UCRL-19414; CONF-700503-8) Avail: NTIS

The application of on-line techniques to the design of beam transport systems is reported. Program TRANSPORT which allows the user to design such systems interactively with a computer through a display console, light pen, and teletype is introduced. The program is capable of providing solutions to first and second order for systems containing a wide variety of beam transforming elements. The versatility of the program is evidenced by the interacting process which permits the experimenter to: 1) view the entire system (or part of it) on a cathode ray tube; 2) observe the beam envelope (or trace rays); 3) observe the transfer matrix and phase space ellipse (or polygon) at any point of the trajectory; 4) change parameters and computer optimize; and 5) perform second order ray tracing. Author (NSA)

N71-12855# Purdue Univ., Lafayette, Ind.
ROTATION INVARIANCE AND THE STRUCTURE OF THE S-WAVE PION PION CROSS SECTION
L. J. Gutay, J. H. Scharenguivel, N. Fuchs, J. Gaidos, D. H. Miller et al Feb. 1970 15 p refs
(COO-1428-174) Avail: NTIS

The isotropic term measured in the pion pion angular distribution in pion production contains two components. One component is invariant, the other transforms like a second rank tensor under space rotation. The pion pion effective mass distribution was determined for the isotropic term in a coordinate system where the tensor component is minimized. A new structure at 0.66 GeV was observed. Author (NSA)

N71-12856# Bettis Atomic Power Lab., Pittsburgh, Pa.
ON THE USE OF SPACE-SYNTHESIS WITH ENERGY GROUP COLLAPSING
J. B. Yasinsky Apr. 1970 23 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-959) Avail: NTIS

Some numerical studies are described aimed at determining the accuracy and reliability of several collapsed-group synthesis methods for few-group neutron diffusion problems. The methods investigated include the weight function scaling approach where the energy group ratios of the trial functions are scaled before they are used as weight functions. Also included are comparisons with a collapsed group synthesis approach which uses only one weight function for each subset of collapsed energy groups. Author (NSA)

N71-12857# Rensselaer Polytechnic Inst., Troy, N.Y.
NEUTRON AND GAMMA-RAY EMISSION FROM HIGHLY EXCITED STATES AND STATES WITH HIGH SPIN Annual Progress Report, 1 Jun. 1969–31 May 1970
Daniel Sperber Mar. 1970 11 p refs
(Contract AT(30-1)-1955)
(RPI-3947-9) Avail: NTIS

The decay of highly excited states and high-spin states was studied with special attention given to neutron evaporation in heavy-ion reactions, population of rotational states in (alpha,xn) reactions, isomer ratios, and angular distributions. The studies are based on the compound nucleus statistical model. Some results on the angular distributions of protons in the Cu-63(C-12,p) and Fe-56(alpha,p) reactions are presented. NSA

N71-12858# Oregon State Univ., Corvallis. Nuclear Chemistry Group.
NUCLEAR CHEMISTRY Progress Report, 15 Mar. 1969–15 Mar. 1970
Walter D. Loveland 15 Mar. 1970 25 p refs
(Contract AT(45-1)-2060)
(RLO-2060-8) Avail: NTIS

The research and developments for this period are reported. The work discussed includes: (1) isomer ratios in charged particle induced fission for Cd-115, Cs-134, U-238, and Th-232, Ra-226, and Bi-209; (2) fission fragment and gamma ray angular correlation in Cf-252 spontaneous fission; (3) transition state nucleus and the fission mass distribution; and (4) nuclear spectroscopy of Z = 50 and N = 82 nuclides. NSA

N71-12859# Los Alamos Scientific Lab., N.Mex.
RELKIN: A TWO-BODY RELATIVISTIC KINEMATICS CODE
J. Davidson, N. Jarmie, and A. Niethammer 18 Dec. 1969 8 p
(Contract W-7405-eng-36)
(LA-4349) Avail: NTIS

RELKIN, a two-body relativistic kinematics code written in FORTRAN IV, is useful in analyzing reactions of the general form A + B = C + D by calculating kinematic quantities for a set of energies (or moments), each energy containing a range of laboratory (or center-of-mass) angles of one of the outgoing particles; photoproduction and two-body decay are handled as special cases. Author (NSA)

N71-12860# Joint Inst. for Nuclear Research, Dubna, (USSR). Lab. of High Energy.
PION-N AND COHERENT INTERACTIONS OF pi-MESONS IN PHOTOEMULSION AT 45 AND 60 GeV/c
Z. V. Anzon, A. Kh. Vinitskii, V. G. Voinov et al 1970 32 p refs In RUSSIAN
(JINR-P1-5072) Avail: AEC Depository Libraries

The results of investigation of pion-nucleon inelastic interactions at 45 and 60 GeV/c, including multiplicity of charged particles, distribution over multiplicity and angular distributions, are presented. The data on coherent generation of particles by the photoemulsion nuclei are obtained. It is shown that the cross section of this process increases with increasing negative-pion energy. Author (NSA)

N71-12861# Oak Ridge National Lab., Tenn.
PRODUCTION OF CHARGED PIONS BY COLLISION OF APPROXIMATELY 600 MeV NEUTRONS WITH THE NUCLEI OF VARIOUS ELEMENTS. 2: DISCUSSION OF EXPERIMENTAL RESULTS
K. O. Oganesyan [1970] 26 p refs Transl. into ENGLISH from Russian Report JINR-P1-3400 Sponsored by AEC Prepared by Sci. Transl. Serv., Ann Arbor, Mich. for ORNL
(ORNL-tr-2347; JINR-P1-3400) Avail: NTIS

A qualitative explanation is given of the fundamental laws of pion production in nuclei by analyzing the set of experimental data obtained in the bombardment of nuclei by neutrons and comparing them with available data for proton beams. NSA

N71-12862# Argonne National Lab., Ill. Chemistry Div.
SOME MEASUREMENTS OF PROMPT NEUTRON FISSION YIELD (ANTI-NU SUB p) IN THERMAL-NEUTRON FISSION OF U 232, Pu238, Pu241, Am241, Cm243, Cm245, AND IN SPONTANEOUS FISSION OF Cm 244
A. H. Jaffey and J. L. Lerner Nov. 1969 54 p refs
(Contract W-31-109-eng-38)
(ANL-7625) Avail: NTIS

The prompt neutron fission yield was measured in thermal-neutron fission of U-232, Pu-238, Pu-241, Am-241, Am-242m, Cm-243, Cm-245, and in the spontaneous fission of Cm-244. These were measured by comparison with prompt-neutron fission yield values of the standards U-233, U-235, Pu-239, and Cf-252. A coincidence method was used, with fission fragments detected in an ionization chamber at close to 100% efficiency, and with fission neutrons detected using four symmetrically placed ZnS(Ag)-methyl methacrylate discs (Hornyak buttons). A small variation of neutron-detection efficiency with fission-neutron spectrum differences was calibrated with the four standard nuclides. The measured values of prompt-neutron fission yield are: U-232, 3.130 + or - 0.060; Pu-238, 2.895 + or - 0.027; Pu-241, 2.874 + or - 0.015, Am-241, 3.219 + or - 0.038, Am-242m, 3.264 + or - 0.024, Cm-243, 3.430 + or - 0.047, Cm-245, 3.832 + or - 0.034, Cm-244, 2.692 + or - 0.024. Author (NSA)

N71-12863# Washington Univ., Seattle. Dept. of Physics.
INELASTIC SCATTERING OF 42-MeV ALPHA PARTICLES BY Mg 26
I. M. Naqib and J. S. Blair [1970] 24 p refs Sponsored by AEC
(RLO-1388-110) Avail: NTIS

Through theoretical analysis, based on both the DWBA version of the extended optical model and the smoother Fraunhofer inelastic diffraction model, values of angular momentum transfer and transition strength were extracted. The combined evidence from the present and other experiments supports the assignments of 3(+)(3.940 MeV), 4(+)(4.331 MeV), and 4(+)(5.485 MeV); also the altered assignment of 4(+) for the 5.71-MeV level and (0,2)(+) for the 5.290-MeV level is suggested. The transitions to the low-lying levels in Mg-26 are found to be similar in character to the corresponding levels in Mg-24, which are presumably members of the lowest K = 0(+) and K = 2(+) rotational bands. However, departures from the simple rotational model are more pronounced in Mg-26 where the nuclear surface appears to be less deformed and more soft with regard to vibrations than Mg-24. Further, fragmented octupole strength is observed, as in Mg-24, in the excitation energy range around 7 to 8 MeV. Author (NSA)

N71-12870# Oregon Univ., Eugene. Dept. of Physics.
THE 8543-keV 6(+) STATE IN Si 28 AND THE GROUND-STATE ROTATIONAL BAND
F. C. P. Huang and D. K. McDaniels [1970] 15 p refs Sponsored in part by AEC
(RLO-1925-33) Avail: NTIS

Evidence for the existence of a ground-state rotational band in the nucleus Si-28 has been rounded out by a lifetime measurement of the 8543-keV 6(+) level. Using the 2203-keV resonance in the Al-27(proton,gamma)Si-28 reaction and the Doppler-shift attenuation technique, 18 + or - 6 fs is found for the mean life of the 6(+) state. It follows that the strength of the 6(+) yields 4(+) 3926-keV transition is 9.4 + or - 3.0 W.u., in good agreement with theoretical predictions. This measurement removes objections that arose from an earlier result of 2.9 W.u. for the 6(+) yields 4(+) transition strength. Author (NSA)

N71-12876# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
NEGATIVE XI HYPERON PRODUCTION IN PION(-) NUCLEON INTERACTIONS
C. Coca and A. Mihul 1970 13 p refs
(IFA-HE-65) Avail: NTIS

An attempt is made to analyze the experimental data available on Xi hyperon (-) production in pion(-) nucleon interactions. Author (NSA)

N71-12877# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
A METHOD FOR SIMULTANEOUS DETECTION OF DALITZ PAIRS AND LOCALIZATION OF PION(0) ORIGINS (THE GLOBAL FIT PROCEDURE)
E. M. Friedlaender and A. G. Marin 1970 16 p refs
(IFA-CR-60) Avail: AEC Depository Libraries

The detection of neutral pions produced in interactions of high energy particles with emulsion nuclei and decaying via the Dalitz mode are reduced to the testing of the zero hypothesis that all the measured tracks emerging from the star originate at a common point. A global fit procedure is applied simultaneously to all grains of the measured tracks; an area around the assumed star origin is scanned, looking for a point where the chi sq of the whole star reaches a minimum. Significantly large chi sq min values are interpreted as evidence for the presence of a Dalitz pair. Electron tracks are found by successive elimination. Results of a Monte Carlo calculation are presented which yield for the first time the rms radius of the circle of confusion around the star origin, as well as confidence levels for the detection of Dalitz pairs. Author (NSA)

N71-12878# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
ABOUT THE BEST STABILITY IN WEIGHTED DISPERSION RELATIONS
G. Nenciu 1970 6 p refs
(IFA-FT-81) Avail: AEC Depository Libraries

Analytic continuation using weighted dispersion relations is discussed. This method is used for the analyticity of the scattering amplitude to obtain supplementary information from experimental data. NSA

N71-12881# Cornell Univ., Ithaca, N.Y. Materials Science Center.
FAR-INFRARED RESONANCES IN YTTERBIUM ORTHOFERRITE NEAR THE SPIN REORIENTATION TEMPERATURE
Kenneth Bernard Aring (Ph.D. Thesis) Jan. 1970 152 p refs
(Contract AT(30-1)-2391)
(NYO-2391-106; Rept-1282) Avail: NTIS

By incorporating the rare earth spins into a spin wave model of the orthoferrites, a theory of the low-temperature magnetic phase transitions found in these compounds is developed. The phase transitions follow from the form of the Fe-Rare Earth exchange interaction. The model includes two iron spins and two Rare Earth spins per unit cell. The iron spins are coupled to each other and to the Rare Earth spins by both symmetric and antisymmetric exchange. A net moment results from the canting of the iron spins and the partial alignment of the Rare Earth spins by their interaction with the iron sublattices. The canting is due to (1) the antisymmetric Fe-Fe exchange, (2) the Fe anisotropy, and (3) the Fe-Rare Earth symmetric exchange. Author

N71-12882# Institute of Nuclear Research, Warsaw (Poland).
APPLICATION OF GRIDDED IONISATION CHAMBER FOR ALPHA SPECTROSCOPY
T. Kempisty 1970 14 p refs In POLISH
(INR-1182) Avail: AEC Depository Libraries

The results of an investigation on a gridded ionization chamber for alpha particle spectroscopy are presented. To establish the optimum operating conditions, certain parameters were measured. The energy resolution for Pu-239 alpha particles E = 5.157 MeV is 1.5%. Author (NSA)

N71-12883# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
ANALYSIS OF A SET OF SPECTRAL INDEX MEASUREMENTS IN MULTIPLYING LATTICES BY APPLYING A CORRELATION METHOD
F. Pistella 15 Dec. 1969 32 p refs
(RT/FI-(69)54) Avail: AEC Depository Libraries

A correlation method, devised to evaluate an unknown reaction rate by means of measured activation rates, is applied to analyze a set of spectral index measurements performed in different uranium fueled lattices. A procedure is suggested to evaluate quantitatively to what extent experimental accuracy in spectral index measurements affects the determination of the reaction rate sought. In addition, the cross section set prepared for the spectral detectors is tested. Author (NSA)

N71-12884# Atomic Energy Establishment, Winfrith (England). Fast Reactor Physics Div.
THE IMPORTANCE OF BREMSSTRAHLUNG IN THE SHIELDING OF GAMMA RAYS HAVING ENERGIES LESS THAN 10 MeV
L. M. C. Dutton Oct. 1969 76 p refs
(AEEW-R-675) Avail: AEC Depository Libraries; HMSO 9s 6d; BIS$1.90

Using Monte Carlo techniques the bremsstrahlung contribution to the dose rate due to 10+ and 6-MeV photons incident on lead and iron shields was evaluated for thicknesses up to 20 mean free paths. The photon energy spectrum on the outside of several shield thicknesses was also determined. The bremsstrahlung energy distribution and that of pair-produced electrons were derived, using the Born Approximation formalism, and the validity of the latter to the present calculation is discussed. The bremstrahlung angular distribution and that of pair-produced electrons was assumed to be perfectly forward peaked, but the validity of this assumption is discussed and the distributions calculated in typical cases. It is found that the bremsstrahlung contribution doubles the dose rate at large penetrations for the case of 10-MeV photons incident on lead shields, but in the other cases considered it never exceeds 20% of the dose rate obtained if bremsstrahlung is neglected. Author (NSA)

N71-12885# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
EFFECTS OF FAST NEUTRON IRRADIATION ON DIFFUSION PHENOMENA IN THE SYSTEM ALUMINUM-MAGNESIUM [EFFETS DE L'IRRADIATION AUX NEUTRONS RAPIDES SUR LES PHENOMENES LIÉ A LA DIFFUSION DANS LE SYSTEME ALUMINIUM-MAGNESIUM]
Guy Moreau 1969 3 p In FRENCH Presented at Intern. Conf. on Atomic Collision Phenomena in Solids, Brighton, England, 7-12 Sep. 1969
(CEA-CONF-1527; CONF-690957-1) Avail: AEC Depository Libraries

The chemical diffusion by means of thick diffusion couples in the aluminum-magnesium system is studied under normal thermal conditions and under fast neutron irradiation (>1 MeV) in a specially designed device implanted in a swimming pool reactor. The mean radiation doses are found to be 10 to the 19th power n/sq cm. The growth of diffusion zones, the evolution of solubility, and the chemical diffusion process are examined. Author (NSA)

N71-12889# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 14 NO. 2
1969 108 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 14, 1969 p 123-134 Prepared for AEC and NSF
(AEC-tr-7027/2; TT-69-50012/2) Avail: NTIS

Research projects conducted by Polish scientists are discussed. Subjects presented are: (1) nuclear physics, (2) nuclear chemistry, (3) electrical engineering, (4) applied nuclear technology, and (5) biology. Author

N71-12897# Cornell Univ., Ithaca, N.Y. Materials Science Center.
STARK EFFECT OF THE R(2) TRANSITION IN KCl
Robert John Reese (M.S. Thesis) Jan. 1970 24 p refs
(NYO-2150-58; Rept-1292) Avail: NTIS

The (1,0,0) and (1,1,0) crystals are studied. Particular attention is paid to differences between data taken with light polarized parallel to and perpendicular to the applied electric field. A polarized bleaching experiment is also considered. Certain orientations of R-centers are optically bleached; this results in a difference in population density among the various center orientations. The resulting changes in the data can be compared to theoretical predictions. Author (NSA)

N71-12898# Purdue Univ., Lafayette, Ind. Dept. of Physics.
MEASUREMENTS OF THE STATIC QUADRUPOLE MOMENT OF THE FIRST EXCITED 2(+) STATES OF THE NUCLEI Pd 108 AND Pd 110 BY HEAVY ION COULOMB EXCITATION
R. Beyer, R. P. Scharenberg, and J. Thomson [1969] 40 p refs
(Contract AT(11-1)-1746)
(COO-1746-32) Avail: NTIS

The static quadrupole moments of the 511.7 keV 2(+) state in Pd-108 and the 373.8 keV 2(+) state in Pd-110 were determined by employing Coulomb excitation techniques. Foils of separated Pd isotopes were bombarded with 25- and 30-MeV O-16 ions and 55- and 56-MeV S-32 ions. The angular distributions of the inelastically scattered ions were measured in coincidence with the de-excitation gamma rays to determine the relative excitation probabilities. The experimental data were fitted using the Winther-de Boer multiple Coulomb excitation program so that the sign and magnitude of the static quadrupole moment could be extracted. The effect of higher excited states on the excitation probability of the 2(+) state was calculated. Self consistency of the oxygen and sulfur data suggests that the excitation via the second 2(+) state interferes constructively so as to increase the excitation probability. Author (NSA)

N71-12899# Michigan State Univ., East Lansing. Cyclotron Lab.
NEUTRON-DEFICIENT MEMBERS OF THE A = 139 DECAY CHAIN. 1: 6.5 HOUR Nd 139m AND 30-MINUTE Nd 139g
D. B. Beery, W. H. Kelly, and Wm. C. McHarris [1969] 86 p refs Sponsored in part by AEC and NSF
(COO-1779-15) Avail: NTIS

The gamma rays emitted following the decays of 5.5-h Nd-139m and 30-min Nd-139g with Ge(Li) and NaI(Tl) detectors in singles, coincidence, and anti-coincidence configurations are studied. The study has indicated 51 gamma rays accompanying Nd-139m decay and 21 that follow Nd-139g decay. Of these, 56 were placed in decay schemes containing a total of 22 excited states. It appears that Nd-139m is one of a few nuclides whose intrinsic structure forces the preferred mode of decay to go into a three-quasiparticle multiplet. The three-quasiparticle states are depopulated by numerous enhanced gamma transitions between states in their multiplet and fewer apparently highly hindered transitions to lower states. Thus, the potential exists for extracting information about states near 2 MeV in this nucleus that normally is available only for states near the ground state. Author (NSA)

N71-12900# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 14 NO. 4
1969 104 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 14, 1969 p 319-424 Prepared for AEC and NSF
(AEC-tr-7027/4; TT-69-50012/4) Avail: NTIS

Coulomb backscattering of heavy charged particles is used in chemical analyses of surface layers and scintillation properties of dioxane-water solutions of some luminophors and physical properties of radiophotoluminescent glazes are evaluated. Ion-molecule reactions in olefin-ND3 systems and gamma radiolysis

of a nitrogen-ethylene gaseous mixture are observed. Determined are natural radioisotopes in chemical elements and microamounts of potassium-42 in the presence of sodium-24 macroamounts. Ion exchange resins are utilized to remove strontium isotopes from milk. Also reported are beta-ray and ionizing radiation measuring methods. NSA

N71-12901# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 14, NO. 3
1969 78 p refs Transl. into ENGLISH from Nukleonika (Warsaw), v. 14, no. 3, 1969 p 235-318 Prepared for AEC and NSF
(AEC-tr-7027/3; TT-69-50012/3) Avail: NTIS

Work in physics constituted beta spectrometer measurements of gamma transitions and accelerator production of targets from gaseous radioactive xenon. Chemical research centered on ferricyanide ion reduction by gamma irradiation, radioisotope isolation from uranium fission products, and removal of radioactive isotopes by precipitation flotation. Also reported are studies on energy spectrum deformation and temperature compensation in Zener diodes. Effects of citrate content induced by fluoracetate on the cesium-144 metabolism in rat organs were also observed. NSA

N71-12902# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
EXPERIMENTAL INVESTIGATION OF THE alpha-CLUSTER STRUCTURE OF Li 6 AND Li 7 WITH AN (alpha, 2 alpha) REACTION AT 104 MeV [EXPERIMENTELLE UNTERSUCHUNG DER ALPHA-CLUSTERSTRUKTUR VON Li6 UND Li7 MIT EINER (ALPHA, 2 ALPHA)-REAKTION BEI 104 MeV]
E. Velten (Ph.D. Thesis) Dec. 1969 67 p refs In GERMAN
(NP-18232) Avail: NTIS

The angular correlations of the reaction (alpha,2 alpha) were measured in symmetric coplanar geometry for investigation of the cluster structure of Li-6 and Li-7 in the angle region between 28 and 47 deg for Li-6 and between 30 and 44 deg for Li-7. The incident energy of the alpha particles was 104 MeV with an energy resolution better than 1 MeV. The model of quasifree scattering, which yields a separation of the three-particle matrix element in one product from two-particle matrix element and pulse distribution of the alpha cluster in the nucleus, was used for the analysis of the measurements. The off-shell matrix element of the alpha-alpha scattering was replaced approximately by the on-shell matrix element of the free alpha-alpha scattering. The pulse distribution of a cluster in the nucleus can be determined both from the angular distribution and from the energy distribution. Author (NSA)

N71-12903# Paris Univ., Orsay (France). Lab. de L'Accelerateur Lineaire.
BACKWARD PHOTOPRODUCTION OF K(+) MESONS FROM HYDROGEN BETWEEN 1 AND 2 GeV
D. Decamp, B. Dudelzak, P. Eschtruth, and Th. Fourneron Jul. 1970 20 p refs Presented to 15th Intern. Conf. on High Energy Physics, Kiev, Aug. 1970
(LAL-1236) Avail: AEC Depository Libraries

At the Orsay Linear Accelerator the photoproduction of positive kaon Lambda hyperon and positive kaon neutral sigma hyperon from hydrogen at photon energies between 1 and 2 GeV, mainly at fixed backward CM angles of emission of the positive kaon meson was investigated. After momentum selection by a magnetic spectrometer the positive kaon mesons were identified by time of flight, specific ionisation measurements and use of a Cerenkov counter. Structures are apparent in the backward photoproduction cross sections at total CM energies around 1700 MeV and around 1900 MeV, rather close to some of the known resonances. Author (NSA)

N71-12905# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
TOTAL CROSS SECTION FOR PHOTOPRODUCTION OF HADRONS ON HYDROGEN AND DEUTERIUM BETWEEN 1.0 AND 6.4 GeV
H. Meyer, B. Naroska, J. H. Weber, M. Wong, V. Heynen et al May 1970 19 p refs
(DESY-70/17) Avail: AEC Depository Libraries

The total cross section for hadron production by photons on hydrogen sigma (gamma p) and deuterium sigma (gamma d) was measured. The experiment used a tagged photon beam with energies from 1.0 to 6.4 GeV and counters surrounding a liquid H2(D2)-target. The cross section on neutrons is determined from the D2 and H2 data using a Glauber correction. Author (NSA)

N71-12906# Illinois Univ., Urbana.
K+p ELASTIC SCATTERING AT 2.53, 2.76 AND 3.20 GeV/c
G. S. Abrams, L. Eisenstein, J. Kim, T. A. O'Halloran, W. Shufeldt et al Apr. 1970 8 p refs Presented at Hyperon Conf., Durham, N.C., Apr. 1970
(COO-1195-191; Conf-700416-3) Avail: NTIS

The resonance at 2.505, which was previously reported, was studied in elastic K(+) + p interactions at 2.53, 2.76, and 3.20 GeV/c in a hydrogen bubble chamber. Also preliminary results of a phase shift analysis at 2.53 GeV/c are presented. NSA

N71-12907# Deutsches Electronen-Synchrotron, Hamburg (West Germany).
P-WAVE AND F-WAVE SOLUTIONS OF RELATIVISTIC QUANTUM MECHANICS FOR BARYON EXCHANGE WITH CUTOFF
J. Katz (Purdue Univ.) and S. Wagner (Hamburg Univ.) May 1970 29 p refs Sponsored in part by AEC
(DESY-70/21) Avail: AEC Depository Libraries

The multichannel relativistic Schrodinger equation is solved for the even parity partial wave amplitudes with a potential obtained by computing the baryon exchange contribution to the pseudoscalar meson-baryon interaction. Physical values are considered together with SU(3) relations among coupling constants and degenerate physical input masses. A cutoff is adjusted to make N sub 3/2(1236) appear at the experimental energy. All p wave piN phase shifts are in qualitative agreement with the CERN phase shifts at low energies and a quantitative fit of the P-33 phase shift is obtained for an F/D ratio of f = 0.48. The calculated 3/2(+) and 1/2(+) baryon spectrum agrees qualitatively with the one obtained previously for an energy dependent baryon exchange potential without cutoffs. In contrast to previous results obtained with an energy dependent potential without cutoffs, exotic 27-plet resonances appear with extremely narrow widths, whereas normal second resonances and the omega(-) are missing, provided the cutoff is adjusted to N sub 3/2(1236). Hence these results are less physical than the previous ones. Author (NSA)

N71-12910# Purdue Univ., Lafayette, Ind. Dept. of Physics.
REACTION PION(+) PROTON YIELDS RHO-MESON(0) DELTA(++) AT 13.1 GeV/c
J. A. Gaidos, R. B. William, J. W. Lamas, C. R. Ezell, and F. T. Meiere (Indiana Univ., Indianapolis) [1969] 15 p refs Presented at 15th Intern. Conf. on High Energy Phys., Kiev Sponsored in part by AEC
(COO-1428-216; CONF-700806-1) Avail: NTIS

The differential cross section and rho-meson density matrix elements for the reaction pion(+) proton yields rho-meson(0) Delta (++) hyperon at 13.1 GeV/c are presented. The data are interpreted in terms of an absorption model with conventional pion exchange. The transverse rho-meson(0) production is compared with the predictions of vector dominance. Author (NSA)

N71-12911# Purdue Univ., Lafayette, Ind. Dept. of Physics.
OBSERVATION OF N(1720) DECAY TO DELTA(1236) PION FROM PION(+) PROTON INTERACTIONS AT 13.1 GeV/c
R. B. Willmann, J. W. Lamsa, J. A. Gaidos, and C. R. Ezell [1969] 13 p refs Sponsored in part by AEC
(COO-1428-175) Avail: NTIS

Evidence is presented for the production of N*(1720) (M = 1719 + or − 6 MeV, Gamma = 63 + or − 12 MeV) and subsequent decay to Delta hyperon(1238) pion in pion(+) proton interactions at 13.1 GeV. Analysis of the sequential decay N*(1720) yields Delta(2+) hyperon pion(−) yields proton pion(+) pion(−) limits the spin to 5/2 or 7/2, with 7/2 favored. If only the lower l wave contributes to the decay, J(p) = 7/2(−). Author (NSA)

N71-12912# California Univ., Berkeley. Lawrence Radiation Lab.
REMARKS ON THE EXISTENCE OF TWO SIGMA (1660) RESONANCES
Robert D. Estes, Jean Duboc, Philippe H. Eberhard, Jerome H. Friedman, Morris Pripstein et al May 1970 4 p refs Presented at the Intern. Conf. on Hyperon Resonances, Durham, N.C., 24–25 Apr. 1970
(Contract W-7405-eng-48)
(UCRL-19824; Conf-700416-1) Avail: NTIS

The quasi two-body reactions K(−) + p yields X(+) + pion(−) are studied in various K(−) + p interactions obtained from an exposure of a hydrogen bubble chamber to a K(−) beam from the Bevatron at 2.1 to 2.70 GeV/c. Special emphasis is placed on the X(+) mass region near 1660 MeV. These data are interpreted to imply the existence of two sigma hyperon(1660) resonances. NSA

N71-12913# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INDUSTRIAL APPLICATIONS OF NEUTRON RADIOGRAPHY: EQUIPMENT AND SOURCES [APPLICATIONS INDUSTRIELLES DE LA NEUTROGRAPHIE : APPAREILLAGES ET SOURCES]
G. Farny 1970 12 p refs In FRENCH Presented at 6th Intern. Conf. on Non-Destructive Testing, Hanover, West Germany
(CEA-CONF-1543; CONF-700613-2) Avail: AEC Depository Libraries

The neutron ejected beam units used for industrial neutron radiography on Triton and Melusine research reactors are presented. The scheme of the standard beam (filter, collimator, shielding) and that of the whole neutron radiography unit installed on the Triton reactor are given. The performances obtained in neutron radiography techniques for the various materials studied are reviewed. The possibilities of extending the techniques presently used to neutroscopy and leakage neutrons are examined. Author (NSA)

N71-12916# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NEUTRON RADIOGRAPHY
G. Farny 4 Mar. 1970 20 p In FRENCH Presented at the Meeting on Nondestructive Testing, Paris
(CEA-CONF-1530; CONF-700320-1) Avail: AEC Depository Libraries

Neutron radiography is viewed as a technique of nondestructive testing complementary to X- and gamma-radiography techniques. The various parts of a neutron radiography unit are analyzed. The source is either a reactor or a radioisotope source or an accelerator. It is an ejected neutron beam in case of inactive sample analysis for industry. The environmental shielding from the ejected beam is provided with a Bi filter. The unit near a reactor is immersed when active material analysis is under consideration. For detection, the neutron information must be transformed into alpha, beta, and gamma particles able to impress a radiographic film by means of a converter. In the direct technique (Gd converter), the film is directly impressed; in the indirect technique (Dy, In converter), activation takes place first, and the film is then impressed in the processing laboratory. Neutroscopy is a modification of the direct technique with a display on a ZnS screen. Author (NSA)

N71-12917# National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.
NIMROD OPERATION AND DEVELOPMENT Quarterly Report, 1 Jan.–31 Mar. 1970
D. E. Gray, ed. May 1970 25 p refs
(RHEL/R-198) Avail: AEC Depository Libraries

Details are given of Nimrod operation January 1 to March 31, 1970, and of the particle physics experimental program undertaken. An energy loss system, employing a new thin-septum magnet in Nimrod's third extracted proton beam, is described. Average intensities at the external target station of 9 times 10 to the 11th power protons per pulse have been measured. A two-element personal dosimeter used on Nimrod is discussed. Some notes are given relating to water-vapor contamination of electrostatic separators and its reduction. Author (NSA)

N71-12923# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimentalnoi Fiziki.
NEW DATA CONCERNING THE LOWER EXCITED LEVELS OF RA 225
E. F. Tretyakov, N. I. Tretyakov, V. F. Konyaev, Yu. V. Khrudev, A. G. Beda et al 1969 20 p refs In RUSSIAN
(ITEF-748) Avail: AEC Depository Libraries

Results of studying conversion electrons, gamma, and alpha emission accompanying the Th-229 decay are given. The scheme of Ra-225 levels is discussed. Author (NSA)

N71-12924# Akademiya Nauk SSSR, Novosibirsk. Inst. Yadernoi Fiziki.
KINETICS OF ELECTRON COOLING OF BEAMS IN HEAVY PARTICLE STORAGE DEVICES
Ya. S. Derbenev et al Jul. 1969 47 p refs Transl. into ENGLISH from Russian Preprint no. 255
(CERN-Trans-69-18) Avail: AEC Depository Libraries

Landau's integral of collisions for Coulomb interaction is used to obtain a kinetic equation for a beam of particles passing periodically through an accompanying stream of electrons. Apart from collisions with electrons, account is taken of scattering on coherent fluctuations (of a non-thermodynamic origin) of the space charge of the electron beam, and on atoms of residual gas. The final kinetic equation is the Fokker–Planck equation in action variables. In the second part, an investigation is made on this basis into the effect, on the kinetic process, of deviations in the electron stream from the state of thermodynamic equilibrium (in the accompanying system). A qualitative investigation is made into the dependence of the attenuation speed and of the stabilized values of angular and energy spread on the velocity distribution of electrons and on the spatial inhomogeneity of the electron beam in a radial direction. Author (NSA)

N71-12925# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
ON THE QUANTUM STATISTICS HAMILTONIANS AND ON THE MODEL HAMILTONIANS OF THE THEORY OF THE SUPERCONDUCTIVITY
D. Ya. Petrina 1970 27 p refs
(ITF-70-36) Avail: AEC Depository Libraries

The general hamiltonian of quantum statistics and the model hamiltonian of the theory of superconductivity at infinite volume are investigated. A rigorous mathematical meaning is given to the hamiltonians as the operators in the Hilbert space of sequences of translationally invariant functions. The general hamiltonian is not symmetric but it has a real spectrum. The model hamiltonian is symmetric and its spectrum has a gap between the energy of the ground and the excited areas. Author (NSA)

N71-12928# Central Research Inst. for Physics, Budapest (Hungary).
ON THE SPINOR TREATMENT OF STATIONARY SPACE-TIMES

Z. Perjes [1969] 27 p refs
(KFKI-70-11-HEP) Avail: AEC Depository Libraries

A generalized SU/2/ spinor calculus is established on the background space V sub 3 of the stationary space-time. The method of spin coefficients is developed in three dimensions. The stationary field equations can be put to a form which in V sub 3 is analogous to the Newman–Penrose equations. A V sub 3 filling family of curves is determined by the gravitational field and is called the eigenray congruence. Stationary space-times may be characterized by the geometric properties of eigenrays. The relation of this classification to the algebraic ones is discussed. The method of solving the equations obtainable for various classes is illustrated on the case of nonshearing geodetic eigenrays. Assuming asymptotic flatness, the Kerr metric is obtained. Author (NSA)

N71-12930# Grenoble Univ. (France). Inst. des Sciences Nucleaires.
STUDY OF THE DECAY OF C-12 INTO 3 alpha [ETUDE DE LA DESINTEGRATION DU C-12 EN 3 alpha]
A. Giorni and D. Kong A Siou [1970] 8 p refs In FRENCH Presented at the Conf. on the Mech. of Nucl. Reactions, Grenoble, France, 16–18 Mar. 1970 Prepared in cooperation with CEA. Lab. Phys. Nucl.
(CEA-CONF-1498; CONF-700313-2) Avail: AEC Depository Libraries

The reaction B-11 + p yields C-12 yields 3 alpha was studied for proton energies of 0.163, 0.68, 1.4, and 2 MeV. The results were compared with a calculation where the reaction amplitude takes into account the formation of C-12 and the alpha-alpha interaction in the final state. The mechanism of the sequential reaction with a single alpha-alpha interaction in the final state leads to a satisfactory explanation of experimental spectra. However, the results relating to the 0(+) resonance of C-12 at E sub p = 2 MeV are not as good because, in this area, the contribution of the close 1(−) and 3(−) levels of C-12 cannot be neglected. Author (NSA)

N71-12931# Institutt for Atomenergi, Kjeller (Norway).
HIGH-EFFICIENCY COUNTING OF BERKELIUM 249 BY A LIQUID SCINTILLATION TECHNIQUE
W. A. van der Heijden and W. Kraak (Reactor Centrum Nederland, Petten) Jan. 1970 15 p refs Prepared in cooperation with Reactor Centrum Nederland, Petten
(KR-139) Avail: AEC Depository Libraries

A liquid scintillation technique for high efficiency counting of Bk-249 is described. A detection efficiency of about 93% was obtained. Author (NSA)

N71-12932# Akademiya Nauk URSR, Kharkov. Inst. Fiziko-Technicheskii.
COMBINATION SCATTERING OF MICROWAVES BY LOW-FREQUENCY OSCILLATIONS IN AN ELECTRODELESS INDUCTION DISCHARGE PLASMA
I. Yu. Adamov, V. L. Berezhnyi, L. A. Dushin, and V. I. Kononenko 1969 11 p refs In RUSSIAN
(KHFTI-69/52) Avail: AEC Depository Libraries

Microwave scattering by low frequency oscillations in an electrodeless induction discharge plasma was studied, using a super-heterodyne receiver operating with fixed frequency and with an adjustable millimeter range generator. The refraction of the plasma probing signal showed a high degree of plasma turbulence with density fluctuations Delta N/N is equivalent to 0.8 + or − 1. It is shown that scattering of microwaves took place on intense longitudinal plasma oscillations propagating almost perpendicularly to the magnetic field with frequencies of omega is equivalent to the square root (sup omega He × sup omega Hi). Author (NSA)

N71-12933# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
EFFECT OF HIGH TEMPERATURES ON THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS: A LITERATURE SURVEY
R. W. Matthews Apr. 1970 18 p refs
(AAEC/TM-537) Avail: AEC Depository Libraries

The literature dealing with the radiation chemistry of aqueous solutions at high temperatures is surveyed in order to evaluate significant differences from ambient temperature radiation chemistry. Particular attention is paid to the effect of these differences on water radiolysis in nuclear reactors. References are complete to the end of 1968 and some 1969 ones are also included. A number of experimental studies are suggested for future research. Author (NSA)

N71-12934# Institute of Nuclear Physics, Krakow (Poland).
ELASTIC AND INELASTIC SCATTERING OF 26 MeV ALPHA PARTICLES ON Si-28, P-31, AND S-32 NUCLEI
K. Chyla, H. Niewodniczanski, J. Szymakowski, U. Tomza, and H. Wojciechowski Mar. 1970 25 p refs
(INP-699/PL) Avail: AEC Depository Libraries

Differential cross sections for the scattering of alpha particles leading to the ground and the first two excited states of Si-28 and P-31 and the ground and first excited states of S-32 were measured over the angular range from 20 deg up to 177.5 deg (Lab. system) at 26.5 MeV. The differential cross sections obtained show well-pronounced maxima and minima. Author (NSA)

N71-12935# United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
AN ACTIVATION TECHNIQUE FOR THE ABSOLUTE CALIBRATION OF A LONG COUNTER
J. M. Adams, A. T. G. Ferguson, and C. D. McKenzie (Melbourne Univ.) Jun. 1970 23 p refs
(AERE-R-6429) Avail: AEC Depository Libraries; HMSO 3s 6d; BIS $0.80

An independent activation technique has been developed and applied to the calibration of the Harwell standard long counter in the neutron energy range from 50 to 1300 keV. The method requires only the accurate knowledge of the total strength of sources of two radioactive nuclei. The results obtained using this technique are compared with the previous estimations which were based on the hydrogen crosssection. Author (NSA)

N71-12936# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PHOTOPRODUCTION OF NEUTRAL RHO MESONS ON DEUTERONS BETWEEN 1 AND 6 GeV. AACHEN BONN HAMBURG HEIDELBERG MUENCHEN COLLABORATION
H. G. Hilpert (Tech. Hochschule Aachen), P. Lauscher (Tech. Hochschule Aachen), M. Matziolis (Tech. Hochschule Aachen), U. Idschok (Bonn Univ.), K. Mueller (Bonn Univ.), et al Apr. 1970 49 p refs Submitted for publication Supported by the Bundesministerium fuer Bildung und Wiss.
(DESY-70/16) Avail: AEC Depository Libraries

The reactions gamma deuteron yields deuteron 2 pion and gamma deuteron yields proton neutron 2 pion were investigated in a deuterium bubble chamber. Invariant mass spectra are presented; rho meson(0) production is dominant in both reactions. Differential and total cross sections for rho meson(0) production were determined. The results are compared with the reaction gamma proton yields proton rho-meson(0) within the framework of the impulse approximation, assuming equal rho-meson(0) photoproduction amplitudes on the proton and the neutron. Author (NSA)

N71-12937# Institute of Nuclear Research, Warsaw (Poland).
THE LEVEL STRUCTURE OF NEAR Pb-208 NUCLEI (NEUTRON-DEFICIENT Pb AND Bi ISOTOPES) [STRUCKTURA POZIOMOW JADER Z POBLIZA PODWOJNIE ZAMKNIETYCH POWLOK Z = 82, N = 126 (NEUTRONOWO-DEFICYTOWE IZOTOPY Pb I Bi)

W. Kusch 1970 120 p refs In POLISH; ENGLISH summary (INR-1169/I/PL) Avail: AEC Depository Libraries

The level scheme structure of the near Pb-208 nuclei, especially of neutron-deficient Pb and Bi isotopes, is discussed. The experimental, as well as theoretical results concerning the calculations of the excited states in the frame of the shell model are presented. The regularity of the level structure revealed by the existence of isomeric states among these nuclei and the effects of the particle-vibration coupling are pointed out. Special attention is paid to the results concerning the Po-204 decay to the excited states of Bi-204 recently obtained by the author. A tentative level scheme for Bi-204 can be proposed on the basis of the results of measurements of the gamma spectra, coincidence gamma-gamma spectra, and electron conversion spectra. Author (NSA)

N71-12938# Institute of Nuclear Research, Warsaw (Poland).
BINDING ENERGY OF A LAMBDA PARTICLE IN NUCLEAR MATTER WITH NONCENTRAL LAMBDA-N FORCES
J. Dabrowski and M. Y. M. Hassan (Heidelberg Univ.) 1970 44 p refs
(INR-1153/VII/PL) Avail: AEC Depository Libraries

The binding energy of a Lambda hyperon particle in nuclear matter, B sub Lambda (infinity), is calculated in the frame of the self-consistent Brueckner K matrix theory. In the K matrix equations pure kinetic energies in the intermediate states are used. The expression for B sub Lambda (infinity), which includes the rearrangement energy, is derived in the case of a Lambda hyperon nucleon interaction which is spin dependent, has a tensor and spin-orbit part, and contains a hard core. Calculations were performed with the modified Herndon–Tang potentials and with a one-boson-exchange potential. The tensor suppression effect is estimated to be about 2 MeV, which includes important contributions of the 3 proton Lambda hyperon nucleon interaction. The role of the self-consistency requirement in the tensor suppression effect is discussed. Author (NSA)

N71-12942# Chicago Univ., Ill. Dept. of Chemistry.
QUANTUM MECHANICAL CALCULATIONS OF LIGHT METAL DIATOMIC HYDRIDES, OXIDES AND HALIDES Semiannual Technical Report, 1 Jun.–31 Dec. 1969
Clemens C. J. Roothaan and Juergen Hinze 31 Dec. 1969 16 p refs
(Contract DA-31-124-ARO(D)-447; ARPA Order 368)
(AD-711973) Avail: NTIS CSCL 7/4

The report very briefly summarizes research concerning wave functions incorporating electron correlation for MgO, LiO, AlO, and TiO. A computer program was developed to determine vibrational f-numbers (or absolute band intensities) from the ground state dipole moments for these systems. Continued studies evaluated and demonstrated the physical reality of SCF calculations by applying them to electron-atom collision problems and comparison with results of independent calculations and experiments. Author (TAB)

N71-12943# California Univ., Berkeley. Lawrence Radiation Lab.
KAON(+) PROTON PARTIAL WAVE ANALYSIS AT 860 TO 1210 MeV/c
B. H. Hall, R. W. Bland, G. Goldhaber, and G. H. Trilling 22 Apr. 1970 8 p refs Presented at the Conf. on Hyperon Resonances, Durham, N.C., 24–25 Apr. 1970
(Contract W-7405-eng-48)
(UCRL-19787; CONF-700416-4) Avail: NTIS

Revised results of a partial-wave analysis of K(+) + p elastic scattering at 860 to 1210 MeV/c are reported. These results are based on new polarization data and previously used differential cross sections. NSA

N71-12947# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
ROTATIONAL BANDS CONSTRUCTED ON THE OCTUPOLE VIBRATIONS
A. Ya. Dzyublik 1970 24 p refs In RUSSIAN
(ITF-70-13) Avail: AEC Depository Libraries

To describe the properties of odd rotational bands observed in some even-even nuclei the adiabatic nonaxial rotator model is used. The rotational energies and ratios of reduced probabilities of E1 transitions between the rotational bands of opposite parity and E2 transitions within the bands of negative parity are calculated. Author (NSA)

N71-12948# Puerto Rico Nuclear Center, San Juan.
RADIATION AND ISOTOPE TECHNOLOGY IN LATIN AMERICAN DEVELOPMENT Topical Meeting Proceedings
May 1969 519 p refs In SPANISH with ENGLISH summaries and in ENGLISH Am. Nucl. Soc. Topical Meeting, San Juan, Puerto Rico, 4–6 May 1969; sponsored in part by Oak Ridge Assoc. Univ.
(Contract AT(40-1)-1833)
(PRNC-135; CONF-690508) Avail: NTIS

Research reports include: (1) information on Brookhaven chemonuclear in-pile research loop; (2) preparation of I-131 labeled allylinulin with high radiochemical yield; (3) progress on polymer-containing fibrous materials around the world; (4) U trace analysis by pulsed reactor irradiation; (5) association of methods of activation analysis and isotopic dilution for determination of Cu in high purity Ag; (6) industrial applications of radioisotopes; (7) remote portable nuclear instrumental methods for elemental analysis; (8) experimental test of mathematical model predicting T movement through a tropical rain forest; (9) measurements of H2O behavior in tropical trees using tritiated water; (10) application of radioisotopic tracers in problems of secondary oil recovery; and (11) a high resolution spectrometer and its use in geology. D.L.G.

N71-12954# Purdue Univ., Lafayette, Ind.
DOUBLE-REGGE ANALYSIS OF THE REACTION PION(+) PROTON YIELDS PION(+) RHO(0) PROTON AT 13.1 GeV/c
J. W. Lamsa, J. A. Gaidos, R. B. Willmann, and C. Ezell Feb. 1970 14 p refs
(COO-1428-170) Avail: NTIS

A double Regge exchange model is compared to the reaction pion(+) p yields pion(+) rho mesons(0) proton at 13.1 GeV/c. The reaction is well described if two diagrams (pion/Pomeron-exchange and rho meson/Pomeron-exchange) are added incoherently. Author (NSA)

N71-12955# Chicago Univ., Ill. Enrico Fermi Inst.
FIXED CUTS AND PION NUCLEON BACKWARD SCATTERING
R. F. Amann Jun. 1970 11 p refs
(COO-264-550; EFI-70-35) Avail: NTIS

The present status of fermion Regge pole theory in backward pion nucleon yields nucleon pion scattering is discussed. Fixed cuts are introduced to remove parity partners and a fit is attempted. However the dip in pion(+)proton yields proton pion(+) scattering, a natural consequence of a nonsense wrong signature zero without the fixed cut, is now impossible to explain with a reasonable N sub alpha residue. Author (NSA)

N71-12988# Brown Univ., Providence, R.I. Dept. of Physics.
RESEARCH PROGRAM IN EXPERIMENTAL HIGH ENERGY PHYSICS Progress Report
Anatole M. Shapiro and Robert E. Lanou, Jr. 1 Jun. 1970 17 p refs
(Contract AT(30-1)-2262)
(NYO-2262-TB-152) Avail: NTIS

A brief review of research on hadron interactions and properties is reported. A list of publications is included. NSA

N71-12959# Idaho Nuclear Corp., Idaho Falls.
NUCLEAR TECHNOLOGY BRANCH Annual Progress Report, Period Ending 30 Jun. 1969
R. M. Brugger and R. L. Heath, eds. Jan. 1970 404 p refs
(Contract AT(10-1)-1230)
(IN-1317) Avail: NTIS

Research progress is reported on experimental techniques, solid state detector development, experimental apparatus and electronics, and cooperative programs with educational institutions. NSA

N71-12968# Purdue Univ., Lafayette, Ind.
REVIEW OF S = MINUS 1 BARYON STATES AS OBSERVED IN PRODUCTION EXPERIMENTS
David H. Miller [1970] 45 p refs Presented at the Intern. Conf. on Hyperon Resonances, Durham, N.C., 24–25 Apr. 1970
(COO-1428-208; CONF-700416-2) Avail: NTIS

The published data on S = −1 baryon states seen in production experiments are reviewed. Concentration is placed on states which are less well established, and the Y^* particles are discussed in order of ascending mass. It is found that the number of states observed in production experiments is small compared to the phase shift data. NSA

N71-12970# Mchigan State Univ., East Lansing. Dept. of Chemistry.
LASER EXCITED RESONANCE FLUORESCENCE OF MOLECULAR IODINE
D. A. Hatzenbuhler and G. E. Leroi Jun. 1970 52 p refs
(Contract N00014-68-A-0109-0003)
(AD-711823; TR-11(36)) Avail: NTIS CSCL 7/4

The laser excited Ar(+) 5145 A and He-Ne 6328A fluorescence spectra of iodine vapor have been obtained. It was found that the Ar(+) 5145 A light excited primarily the 43-0 P(12) and 43-0 R(14) transitions, with approximately equal intensity. A small amount (about 3%) of fluorescence from an excited state connected with a v = 1 ground state having a high rotational level (J > or = to 100) was also observed. The He-Ne laser excited primarily the 6-3 P(33) transition, along with a small amount of the 11-5 R(127) transition. The effects of collisional processes on the excited iodine molecules is quite marked, and accounts for the remaining features observed in the spectra. Author (TAB)

N71-12971# Atomic Energy Commission, Washington, D.C.
REPORTS TO AEC NUCLEAR CROSS SECTIONS ADVISORY COMMITTEE MEETING
R. E. Chrien, comp. 19 Sep. 1969 281 p refs Conf. held at Houston Tex., 18–19 Sep. 1969
(WASH-1136; EANDC-122-U; INDC-14-U; CONF-690937) Avail: NTIS

Neutron and nculear cross section data, relevant to the applied nuclear energy program, are presented. The data include microscopic neutron cross sections, charged particle cross sections gamma ray production and radioactive decay, and proton and alpha particle cross sections at energies of up to 1 GeV. N.E.N.

N71-12972# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 14, NO. 1
1970 114 p refs Transl. into ENGLISH Nukleonika (Warsaw), v. 14, no. 1, 1969 p 1–122 Prepared for AEC and NSF
(AEC-TR-7027/1; TT-69-50012/1) Avail: NTIS

Research in physics, chemistry, and engineering and equipment related to nucleonic is reported. Topics studied include the following: targets for producing dD neutrons; semoconductor position-sensitive detectors; flotation of molybdate anions; carbon 13 kinetic effects in decarboxylation; treatment of waste waters containing thorium; pair selection methods in collection of most probable events in multiparameter experiments; analysis of fluctuations in integrating circuits; belt conveyor isotopic weigh probes; pulsed NMR spectrometer tuning; electrolytical enriching of water in tritium; quantitative autoradiography; and radioactivity of water in a shallow barrage reservoir. N.E.N.

N71-12974# Pennsylvania Univ., Philadelphia. Dept. of Physics.
ETA MINUS PION(O) MIXING IN KAON(+) YIELDS PION(+) PION (O) DECAY
Ashok Goyal, Ling-Fong Li, and Gino Segre [1970] 7 p refs
(NYO-2171-316) Avail: NTIS

The effect of a possible virtual eta meson yields neutral pion transition on the positive kaon yields positive pion neutral pion decay using the general U-spin consideration and also by allowing the transition to be induced by a nonelectromagnetic isospin violating term in the Hamiltonian is discussed. Author (NSA)

N71-12975# New York Univ., N.Y. AEC Computing and Applied Mathematics Center.
EXACT SOLUTION OF THE FIRST-ORDER PERTURBED PERCUS-YEVICK EQUATION FOR ARBITRARY PAIR POTENTIALS
Jerome K. Percus and Sheldon Shanack Jun. 1970 78 p refs
(Contract AT(30-1)-1480)
(NYO-1480-151) Avail: NTIS

The effect upon the correlation functions of a fluid of adding a pair potential of arbitrary range to a repulsive hard core is investigated in the case of the Percus-Yevick approximation of classical equilibrium statistical mechanics. The nonlinear P.Y. equation is perturbed, to first-order, and the resulting linear integral equation for the first-order correlation functions is then solved exactly for a general interparticle potential. The method of solution is presented for one-dimensional systems, but three-dimensional non-polar and polar liquids can be encompassed. Essential to the technique is the calculation of a certain zeroth-order quantity, which is proportional to the Faltung of the hard core pair correlation function with itself, and which is composed of a sum of nth-neighbor contributions. Author

N71-12991# Illinois Univ., Urbana. Dept. of Physics.
THE REACTION PION(−) PROTON YIELDS PROTON PION(−) OMEGA MESON (o) AT 5.0 AND 7.5 GeV/c
G. Ascoli, C. A. Bridges, D. V. Brockway, H. B. Crawley, L. B. Eisenstein et al Jun. 1970 8 p refs Presented at 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug.-4 Sep. 1970 Sponsored in part by AEC
(COO-1195-188; CONF-700806-20) Avail: NTIS

Some results on the production of the B meson in the reaction negative pion plus proton yields negative pion plus neutral omega meson plus proton at 5.0 and 7.5 GeV/c in hydorgen bubble chambers are presented. The mass and width of the B meson are determined, and also the spin and parity are found from the decays B yields neutral omega meson plus negative pion, neutral omega meson yields positive pion plus negative pion plus neutral pion. NSA

N71-12992# Columbia Univ., Irvington, N.Y. Nevis Labs.
A SEARCH FOR EVIDENCE OF OMEGA MESON YIELDS PION(+) PION(−) IN PION(+) PROTON YIELDS PION(+) PION(−) NEUTRON AND A STUDY OF THE OMEGA MESON YIELDS PION(+) PION(−) PION (0) DALITZ PLOT
Thomas Nash (Ph.D. Thesis) 1970 132 p refs
(Contract AT(30-1)-1932)
(NEVIS-182; CU-286; R-717) Avail: NTIS

Evidence of omega meson yields positive pion negative pion was sought in a sample of 9696 negative pion proton yields positive pion negative pion neutron events taken at beam momentum of 1245 MeV/c. The branching ratio was measured for a series of assumptions of rho mesons minus omega mesons coherence and relative phase angles. The results set upper limits at

the 90% confidence level of B < 2.9% for incoherence, B < 17.9% for coherence and destructive interference, B < 0.51% for constructive interference, and B < 3.0% for phi=pi. Also the Dalitz plot asymmetry of an accompanying sample of about 7600 omega meson yields negative pion positive pion neutral pion events in negative pion proton yields positive pion negative pion neutral pion to be A = −0.014 + or − 0.028 was measured. The nonresonant background was subtracted from these data in 28 independent Dalitz plot regions. The Dalitz plot distribution of the omega meson events agrees very well with the simplest matrix element for a J sup p = 1 (−) particle and shows no evidence of any rho meson dominance effects. Author (NSA)

N71-12999# North Carolina Univ., Chapel Hill. Dept. of Physics.
ULTRASONIC PARAMETERS IN THE BORN MODEL OF THE RUBIDIUM HALIDES
R. W. Roberts and Charles S. Smith Nov. 1969 24 p refs
(ORO-3802-5; TR-4) Avail: NTIS

Values of all dC/dP have been obtained at 295 K and are strikingly smooth when plotted against nearest neighbor distance, d sub o. When combined with known temperature coefficients of the elastic constants, they lead to values of xi = dlnb sub T/(dT) sub V which are uniformly −0.0001/deg for these crystals with low Debye temperature. The resulting Born model exponential parameters, d sub o/rho, are precisely linear with d sub o, in contrast with d sub o/rho values where compression xi were used in the necessary correction for vibrational effects. Values of dB sub T/dP are uniformly 5.6, a general magnitude well accounted for by the Born model which, however, predicts a significant systematic variation in the four halides. In all these features the Rb halides are similar to the Na and K halides. Author

N71-13000# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
CONFIGURATION MIXING CORRECTIONS TO THE SILICON 1s-A(1) SHALLOW DONOR WAVE FUNCTION
T. G. Castner, Jr., E. B. Hale, and R. Craven Jul. 1970 16 p refs
(Contract AT(30-1)-3388)
(UR-3388-21) Avail: NTIS

Discrepancies between experimental Si-29 hyperfine constants on shallow donors from electron-nuclear double-resonance (ENDOR), including new piezohyperfine constants measured with applied [001] axis uniaxial stress, and calculated hyperfine constants employing the Kohn-Luttinger wave function based on the six delta sub 1 minima with configuration mixing wave function corrections for the 1s-A sub 1 state were considered. It is shown that admixtures from the low energy L sub 1, K sub 1, and U sub 1 regions of the lowest conduction band substatially improve the agreement between calculated and experimental Fermi contact constants for identified ENDOR shells for As, P, and Sb donors. These corrections help identify several new shells and lead to a more accurate identify several new shells and lead to a more accurate determination of the delta sub 1 minimum position. Author

N71-13006# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
IDENTIFICATION OF THE REACTIONS AT HIGH ENERGIES
O. V. Dumbrais and G. I. Kopylov 1970 3 p refs In RUSSIAN
(JINR-P1-5123) Avail: AEC Depository Libraries

At energies in the range of a few tens of GeV where the usual methods of identification of reactions fail, the introduction of a functional permitting tests of the hypothesis of resonance production makes it possible to distinguish the groups of reactions where resonances are produced from those without resonance production. An attempt to separate different reactions with the production of resonances fails. Author (NSA)

N71-13122# Oak Ridge National Lab., Tenn. Isotopes Information Center.
ISOTOPES INFORMATION CENTER KEYWORD THESAURUS
Robert H. Lafferty, Jr., ed. Aug. 1970 115 p Revised
(Contract W-7405-eng-26)
(ORNL-IIC-24-Rev-1) Avail: NTIS

The thesaurus of keywords is presented in both hierarchical and alphabetical arrangement, together with a cross-reference list and some instructions on indexing. Author

N71-13188# Oxford Univ. (England). Dept. of Nuclear Physics.
NUCLEAR STRUCTURE STUDIES USING NUCLEON AND MESON INTERACTIONS Final Scientific Report
D. H. Wilkinson 30 Jun. 1970 13 p refs
(Contract F61052-67-C-0104)
(AD-712728; AFOSR-70-2398TR) Avail: NTIS CSCL 20/8

Information on Nuclear Structure has been obtained in terms of the shell and collective models from data on energy levels, transition rates and multipole moments and interpretation of scattering and stripping experiments performed on the Oxford accelerators and elsewhere. Author (TAB)

N71-13189# Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products.
BREMSSTRAHLUNG PRODUCTION
David G. Brown Jul. 1970 28 p refs
(PB-192888; BRH/DEP-70-18) Avail: NTIS CSCL 20H

An understanding of bremsstrahlung production is basic to the understanding of X-radiation from electronic products. A bremsstrahlung literature survey was conducted and a program of experimental research on bremsstrahlung production was begun. The literature survey revealed severe deficiencies in present knowledge about bremsstrahlung. Author (USGRDR)

N71-13224# Maryland Univ., College Park, Md. Dept. of Physics and Astronomy.
STRONG INTERACTION EXPERIMENT ON MT. CHACALTAYA Final Report
Gaurang B. Yodh Aug. 1970 22 p refs
(Contract F44620-69-C-0019)
(AD-712735; AFOSR-70-2398TR) Avail: NTIS CSCL 20/8

The document summarizes the status of the experimental apparatus at the time of termination of the contract. The energy measuring device (calorimeter), which has been constructed, is described. The status rest of the apparatus: beam telescope, electronics, spark chamber system, targets and transition radiation detector design is given. In addition, a complete list of all publications under this contract is included. Author (TAB)

N71-13235# Harvard Univ., Cambridge, Mass. Lyman Lab. of Physics.
CYCLOTRON OPERATIONS, PART A. RESEARCH ON THE PROPERTIES OF NUCLEI, PART B. NUCLEAR MAGNETISM, PART C. MOLECULAR BEAM RESEARCH, PART D Final Report, 1966 −1970
1970 38 p refs
(Contract Nonr-1866(56))
(AD-712853) Avail: NTIS CSCL 20/7

Contents: Cyclotron operations; Research on the properties of nuclei; Nuclear magnetism; Molecular beam research. TAB

N71-13244# Southeastern Massachusetts Univ., North Dartmouth. Dept. of Physics.
PROBLEMS IN SOFT PION AND REGGE THEORY Final Technical Report

George Y. Leung 14 Sep. 1970 30 p refs
(Grant AF-AFOSR-1711-69)
(AD-712740; AFOSR-70-2401TR) Avail: NTIS CSCL 20/8

The paper is theoretical in nature and the objective is to investigate several problems in high energy and elementary particle physics of current interest and to attempt to gain a better understanding of these problems. The investigations in this field are normally divided into theoretical and experimental studies. For some of the proposed problems of investigations, there is no lack of experimental data, and constant comparisons with the experimental results guide the direction of pursuit. An outline of these studies is presented in this report. TAB

N71-13267# Hamburg Univ. (West Germany). Fachbereich Physik.
Pi(−)p INTERACTIONS WITH TWO CHARGED SECONDARY PARTICLES AT A PRIMARY MOMENTUM OF 11 GeV/c [Pi(−)p-WECHSELWIRKUNGEN MIT ZWEI GELADENEN SEKUNDAERTEILCHEN BEI EINEM PRIMAERIMPULS VON 11 GeV/c]
Peter-Klaus Schilling (Ph.D. Thesis) 1970 163 p refs In GERMAN
Avail: NTIS

The analysis of particle production in pion-proton interactions shows a strong double-peripheral character which can be explained by a substantial share of nucleon diffraction dissociation. The nonresonant portions of the reactions can be explained by a multi-Regge model. The diffractive portion can be explained satisfactorily by an extended Veneziano model. ESRO

N71-13279# Hamburg Univ. (West Germany). Fachbereich Physik.
A SOURCE FOR POLARIZED LITHIUM NUCLEI IMPROVED BY HIGH FREQUENCY TRANSITIONS AND MEASUREMENT OF THE POLARIZATION USING THE REACTION H2(Li6, He4)He4 [EINE DURCH HOCHFREQUENZUEBERGAENGE VERBESSERTE QUELLE POLARISIERTER LITHIUMKERNE UND MESSUNG DER POLARISATION MIT HILFE DER REAKTION H2(Li6, He4)He4]
Uwe Holm (Ph.D. Thesis) 1970 72 p refs In GERMAN
Sponsored by Bundesmin. fuer Bildung und Wiss.
Avail: NTIS

Two high frequency transitions were used in an atomic beam furnace to polarize lithium atomic beams. The tensor polarization of the lithium nuclei was determined by means of the H2(Li6, He4)He4 reaction. The ionization of the polarized lithium beam, due to the Langmuir-Taylor effect, retained the lithium 6 nuclei polarization to at least 70 per cent. Author (ESRO)

N71-13280# Hamburg Univ. (West Germany). Zweites Inst. fuer Experimentalphysik.
ELECTRIC AND MAGNETIC MOMENTS MEASUREMENT OF F-18 AND Na-22 USING THE SPIN ROTATION METHOD AFTER NUCLEAR REACTIONS [MESSUNGEN ELEKTRISCHER UND MAGNETISCHER MOMENTE DER KERNE F-18 UND Na-22 MIT DER SPINROTATIONSMETHODE NACH KERNREAKTIONEN]
Juergen Morgenstern (Ph.D. Thesis) 1969 80 p refs In GERMAN
Avail: NTIS

The life times, g-factors, and quadrupole moments of excited nuclear states of F-18 and Na-22, and the static electrical nuclear quadrupole interaction of the 5/2(+) state of F-19 in A4-lattices, graphite, and quartz were measured, from which new results of the structure of these excited states were obtained. The experimental results were compared to the shell and the collective model to test their validity. It appears that this measuring method is widely applicable in nuclear and solid state physics. ESRO

N71-13374# New York Univ., N.Y. Dept. of Physics.
ELECTRON SCATTERING Final Report, 1 Mar. 1964 – 31 Jan. 1970
Benjamin Bederson 1 Oct. 1970 12 p
(Contract Nonr-285(60); ARPA Order 125)
(AD-712541) Avail: NTIS CSCL 7/4

The principal subjects of investigation were experimental and theoretical aspects of atomic collisions and atomic structure. Lists of contributed papers, invited talks, lectures and colloquia, published papers and other related activities, and of students who have received their Ph.D. degrees under ARPA support are given. Author (TAB)

N71-13377# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PRODUCTION OF POSITIVE IONS AND ELECTRONS IN COLLISIONS OF 1-25 KeV PROTONS AND HYDROGEN ATOMS WITH CO, CO2, CH4, AND NH3
Robert J. McNeal 25 Sep. 1970 29 p refs
(Contract F04701-70-C-0059)
(AD-712689; TR-0059(9260-01)-9; SAMSO-TR-70-359) Avail: NTIS CSCL 7/4

Cross sections are reported for the production of slow, positive-ions (sigma(+)) and electrons (sigma(-)) in collisions of 1-25 keV protons and hydrogen atoms with CO, CO2, CH4, and NH3. For H(+) bombardment sigma(-) is the total ionization cross section, and sigma(+) - sigma(-) is the total electron capture cross section, sigma 10. For H(o) bombardment sigma(+) is a good approximation to the total ionization cross section. The results are compared with other results in different, overlapping energy ranges, and their application to the physics of planetary atmospheres is discussed. Author (TAB)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N71-12635# Princeton Univ., N.J. Plasma Physics Lab.
PRODUCTION OF PLASMAS BY LONG-WAVELENGTH LASERS
John M. Dawson Jun. 1970 6 p refs Presented at AIAA 3rd Fluid and Plasma Dynamics, Los Angeles, 29 Jun. – 1 Jul. 1970
(Contract AT(30-1)-1238)
(MATT-786; CONF-700615-1) Avail: NTIS

The possibilities of applying long-wavelength lasers, in particular the 10 micron CO2 laser, to the problems of controlled thermonuclear reactions are considered. Radiation at wavelengths of 10 microns or longer can effectively heat plasmas to temperatures in the keV range at densities that can be confined by available magnetic fields. Such lasers would be a versatile tool for producing experimental plasmas and might provide plasma for a reactor. The physics of producing plasmas by this means as well as some possible devices is considered. Author (NSA)

N71-12636# Oak Ridge National Lab., Tenn. Thermonuclear Div.
FRACTIONAL FRINGE HCN LASER-INTERFEROMETER
J. N. Olsen (Ph.D. Thesis – Ohio State Univ.) Aug. 1970 14 p refs Submitted for publication
(ORNL-TM-3092) Avail: NTIS

An HCN laser-interferometer is reported with better than 1/100th of a fringe phase-shift sensitivity at a wavelength of 337 microns. Applied to plasma density measurement this corresponds to electron density line integrals of 3.3 × 10 to the 12th power per square centimeter or lower. The fractional fringe technique involves sinusoidally driving the reference path mirror in a focused Michelson interferometer; changes in the effective path length alter

the relative magnitude of even and odd harmonics in the resultant interferometer signal. Results are shown from application of this diagnostic to the Burnout V plasma. Author (NSA)

N71-12640# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Physics.
SPATIAL DAMPING OF LARGE AMPLITUDE PLASMA WAVES
A. Lee and G. Schmidt Dec. 1969 25 p refs
(Contract AT(30-1)-3785)
(SIT-3785-10; SIT-245) Avail: NTIS

Using both the quasi-linear treatment of Altshul and Karpman, and following exact particle trajectories of resonant particles as done by O'Neil for the temporal case, it was found that the spatial damping results are analogous to the temporal ones. Changing the nondimensional time and damping coefficient for the temporal case into the distance and spatial damping coefficient respectively, results in the spatial damping formula. Damping curves were plotted for comparison with measured data. The validity condition of the spatial case is far more stringent than for the temporal one. Author (NSA)

N71-12679*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
NONEQUILIBRIUM PLASMA BOUNDARY LAYER OVER A CATHODE
Robert Kincaid Seals, Jr. (Ph.D. Thesis) 1970 68 p refs
(Grant NGR-34-002-048)
(NASA-CR-111611) Avail: NTIS CSCL 20I

An analysis of the nonequilibrium plasma boundary layer over a cathode in the presence of a magnetic field is presented. The case considered is that where the Debye length is less than the mean free paths and the Larmor radii, and where the thermal and nonequilibrium effects are important. The solution is obtained by matching the sheath solution and the solution of the conservation equations of the plasma constituents. The transport properties for a partially ionized gas in the presence of nonequilibrium ionization and magnetic fields are obtained from appropriate equations derived by the thirteen moment method. Local similarity is assumed, and the problem is solved numerically using an integral method on an IBM Model 360-75 digital computer. Results are presented for a range of values of magnetic fields and axial distance and for two values of wall temperature. The results indicate that the heat flux at the wall, the current density, and the electron temperature all tend to increase with increasing magnetic induction. Author

N71-12752# Princeton Univ., N.J. Plasma Physics Lab.
NUMERICAL SIMULATION OF PLASMAS AT PRINCETON 1 Technical Report, 1 Apr. –31 Dec. 1969
J. M. Dawson, W. L. Kruer, J. P. Boris, J. H. Orens, C. Oberman et al 31 Dec. 1969 39 p refs Sponsored in part by AEC
(Contract N00014-67-A-0151-0021)
(AD-712562) Avail: NTIS CSCL 20/9

A program on numerical plasma simulation was undertaken. The following codes were developed: One- and two-dimensional models using finite-sized particles and including only electrostatic interactions between particles; One, one and a half (two velocities and one position), two, and two and a half (three velocities and two positions) codes were developed using finite-sized particles, electrostatic particle interactions and a fixed magnetic field; A three-dimensional magnetohydrodynamic fluid model was developed. Extensive checks on the accuracy and reliability of the codes were made. The codes were applied to a number of problems in plasma turbulence and nonlinear behavior. Brief summaries of the work are attached. They are taken from the Annual Report of the Princeton Plasma Physics Laboratory. TAB

N71-12801# California Univ., Santa Barbara.
AN OPTICAL SPECTROSCOPIC INVESTIGATION OF HELIUM AND NITROGEN PLASMAS
Melvyn Samuel Manalis (Ph.D. Thesis) Jun. 1970 161 p refs
(Contract N00014-69-A-0200-8004; ARPA Order 125)
(AD-712024; TR-31) Avail: NTIS CSCL 20/9

Energetic species and their respective energy exchange processes in a cool, high density helium plasma has been reviewed. Light from a flowing helium afterglow was observed from 2500 to 10,500 A using an Ebert double-pass scanning monochromator coupled to standard dc detecting equipment. Experimental data in the form of relative populations of atomic helium states provided motivation for a theory which may explain the manner in which ionization is maintained in the afterglow region of the helium plasma. A bimodal electron distribution was found to exist in this plasma. Molecular nitrogen was used as a probe to detect various energetic species present in the helium afterglow. In addition to the usual systems observed when N2 is injected into the helium afterglow, light from many levels of atomic nitrogen and three new vibrational population distributions of the first positive system of molecular nitrogen were observed. Two independent mechanisms for exciting the atomic nitrogen were isolated. Author (TAB)

N71-12802# Westinghouse Research Labs., Pittsburgh, Pa.
BASIC PLASMA PROCESSES Final Report, 1 Jul. 1969 –30 Sep. 1970
A. V. Phelps and C. L. Chen 30 Sep. 1970 59 p refs
(Contract N00014-70-C-0128)
(AD-711828; Rept-70-9C8-CSRAD-R1) Avail: NTIS CSCL 20/9

A theory was developed describing the magnitude and wavelength dependence of the resonance radiation emitted as the result of thermal excitation. The predictions of the theory are compared with the results of measurements at a temperature of 788 K as obtained in a cell capable of operating up to 1050 K. The absorption coefficients and total absorption for the cesium resonance lines at 8944, 4593, and 4555 A for cesium in argon at pressures near atmospheric have been measured over a wide range of cesium densities and found to scale as the product of the cesium and argon densities. These results are consistent with broadening as the result of binary collisions between cesium and argon atoms. Our theory of resonance fluorescence for optically thick systems is found to give good agreement with experiments in which mercury was illuminated with a resonance line source. The dominant loss mechanism at moderate and high densities is diffusion to the window. Significant discrepancies remain between the theory and our measurements in cesium using a white light source. Author (USGRDR)

N71-12891# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
CHARACTERISTICS OF COLLISIONLESS DAMPING OF ELECTROMAGNETIC WAVE IN A REGION OF INTENSE INHOMOGENEITY OF A COLD PLASMA
V. V. Dolgopolov and A. Ya. Omel'chenko 1970 15 p refs In RUSSIAN
(KHFTI-69/53) Avail: AEC Depository Libraries

Electromagnetic oscillations resulting from the initial perturbations at the boundary of a semi-finite plasma and a vacuum were studied, taking into account the finiteness of the transition region from the homogeneous plasma to the vacuum and, also, an inhomogeneous plane-parallel plasma layer. Three cases are considered: the case in which the length of the wave propagating along the layer is considerably larger than the width of the layer, the case in which the length of the wave is comparable to the width of the layer, and the general case in which there is an arbitrary ratio between the wave length and the width of the layer. Author (NSA)

N71-12892*# Rensselaer Polytechnic Inst., Troy, N.Y. Plasma Dynamics Lab.
INSTABILITIES AND TURBULENCE IN HIGHLY IONIZED PLASMAS IN A MAGNETIC FIELD Semiannual Status Report, 1 Mar. –31 Aug. 1970

J. H. Noon, G. Huchital, and W. C. Jennings Oct. 1970 40 p refs
(Grant NGR-33-018-137)
(NASA-CR-111514; TR-70-2) Avail: NTIS CSCL 20I

Correlation studies show that some degree of coherence exists throughout the whole of the observed plasma turbulence spectrum, although time and length scales of coherence decrease markedly with increasing frequency. Propagation characteristics and energy dissipation mechanisms of these turbulent eddies are being investigated. The growth of a strongly coherent drift wave instability is associated with an increase in amplitude of the high frequency end of the turbulence spectrum. On the other hand growth of another type of coherent oscillation (an ion acoustic wave) reduces the amplitude of the turbulent spectrum, but only in the frequency regions adjacent to that of the strong coherent oscillation. Author

N71-12893# Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland).

MEASUREMENT OF IONIC TEMPERATURES IN A PINCH OF A ROTATING MAGNETIC FIELD [MESURES DE TEMPERATURES IONIQUES DANS UNE STRICTION A CHAMP MAGNETIQUE TOURNANT]

A. Berney Jun. 1970 83 p refs In FRENCH; ENGLISH summary
(LRP-40/70) Avail: AEC Depository Libraries

Ion temperature measurements were made by means of Doppler line broadening in a rotating magnetic field pinch experiment. A 12-channel Fabry–Perot interferometer was constructed and profiles of various helium and impurity lines were measured as functions of time and position in the discharge tube. The theoretical standard deviation of the results was computed by a statistical analysis, using a Monte Carlo simulation program. This allowed one to separate the real variations of the plasma from the fluctuations of the measurements. The main limitations of the accuracy of the results were due to lack of light intensity and parasitic broadening mechanisms (Stark and reabsorption effects). Nevertheless, reasonable values of the temperatures of ionized nitrogen, oxygen, and helium were obtained for three different filling pressures (20, 60, and 180 mtorr He). Author (NSA)

N71-12894# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.

EFFECTIVENESS OF CURRENT HEATING IN A DENSE HIGH-CURRENT GAS DISCHARGE PLASMA

N. A. Manzyuk, V. A. Suprunenko, E. A. Sukhomlin, and A. M. Ternopol 1969 10 p refs In RUSSIAN
(KHFTI-69/43) Avail: AEC Depository Libraries

The physical effectiveness of current heating of a dense high-current gas-discharge plasma stabilized by a strong magnetic field was studied. The heating effectiveness was about 60%. The current heating continued throughout the current flow in the active discharge region. Author (NSA)

N71-12929# Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland).

NUMERICAL COMPUTATION TO DESIGN A ROTATING FIELD PINCH EXPERIMENT

E. S. Weibel and A. Lietti Jun. 1970 21 p refs
(LRP-44/70) Avail: AEC Depository Libraries

The model proposed is a simple one, describing the dynamics of a rotating-field pinch in terms of the macroscopic quantities: temperature, pressure, plasma radius, and magnetic field strength. The field is obtained by producing oscillating currents in resonant circuits, which are fed by line rf pulse generators. The computation takes into account the equations of the electrical system and of the gas dynamics. The result of this computation is compared with the result of an experiment performed in a 5 × 50 cm discharge tube. The amplitude program, which is necessary in order to confine the plasma in a new experiment on a larger scale, is established. Author (NSA)

N71-12969# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.

ELECTRONIC STRUCTURE OF 33 AR ION CLUSTER

Masataka Mizushima (NAS) Apr. 1970 29 p refs Supported in part by NAS
(IFA-FT-82) Avail: AEC Depository Libraries

Theoretical calculations are presented of the electronic structure of a cluster ion with the icosahedral symmetry, such an ion(+) with 33 Ar atoms. The proposed structure is obtained by placing one each argon atom at the center, at each of twelve vertices, an at outside of each center of twenty triangular faces, of an icosahedron. NSA

N71-13027*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL RESULTS OF HIGH-CURRENT ARCS DRIVEN SUPERSONICALLY IN STRAIGHT AND CIRCULAR CHANNELS

Alexander P. Saboi, Roger B. Stewart, and Roy J. Duckett Washington Dec. 1970 35 p refs
(NASA-TN-D-6086; L-6890) Avail: NTIS CSCL 20I

Quantitative information concerning the static pressure associated with moving arcs and the arc velocity as a function of the Lorentz force for arc currents as high as 8000 amperes is given for magnetic-field strengths of 0.64 and 1.28 webers/sq meters. With the aid of ultra-high-speed photography and rapid-response pressure gages, results revealed that a single abrupt bow shock ahead of the arc did not occur but that a network of many small primary shocks preceded the luminous zone. In the circular channel tests, different gases and air were used at different densities. These tests, in which the arc ran through its own heated wake, indicated that the arc velocity is faster than that in a straight channel and depends on the gas density to the one-half power for the steady-state condition. During arc start-up periods, the arc velocity is approximately linearly dependent on the applied Lorentz force. Author

N71-13063# Naval Research Lab., Washington, D.C.

CONFINEMENT OF LASER-PRODUCED PLASMA IN RESONANT CAVITIES BY RF ELECTROMAGNETIC FIELDS

Final Report
Stephen O. Dean 28 Sep. 1970 20 p refs
(AD-713064; NRL-7136) Avail: NTIS CSCL 20/9

The use of rf electromagnetic fields to confine dense high-temperature plasma has been considered unpromising because of the high electric fields required (greater than one million V/cm), and primarily because the ohmic energy losses in normal-conducting cavity walls are huge in comparison to all other energies involved, including possible thermonuclear yields. The very high fields required are today within reach. The advent of superconducting cavities with Qs exceeding 10 billion reduces ohmic wall losses to a negligible value (approximately 1/100) of thermonuclear yield. Two other problems arise, however: (a) what are the effects of rf interactions with the plasma sheath, and (b) is it possible to maintain a superconducting surface in the presence of plasma bremsstrahlung. Inadequate information exists with which to draw firm conclusions on whether or not these problems preclude the possibility of an rf-confined thermonuclear reactor. Many of the physics questions may possibly be studied in a laser-produced plasma experiment, such as the one described. Author (TAB)

N71-13178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHYSICAL PROCESSES IN ELECTROMAGNETIC SHOCK TUBES

Yu. V. Makarov et al 16 Jul. 1970 286 p refs Transl. into ENGLISH from Fiz. Protsessy v Elektromagnitnykh Udarnykh Trubakh (USSR), 1968 p 1–267
(AD-713030; FTD-HC-23-416-69) Avail: NTIS CSCL 20/9

The monograph deals with experimental research into the physical properties of plasma behind powerful shock waves arising

during a powerful impulse discharge. The results are presented of experimental studies of the structure of the luminosity front in electromagnetic shock waves, the state of the gas behind a shock wave, the properties of plasma along the discharge chamber, and magnetic fields in the plasma. The difficulties and prospects for using electromagnetic shock tubes for a wide range of physical studies are examined. Various methods were used while carrying out experiments, including optical, spectral, contact, high-frequency, electromagnetic, and other studies. Physical phenomena in electromagnetic shock tubes are examined only from the gas dynamics point of view. Author (TAB)

N71-13190# Harry Diamond Labs., Washington, D.C.
AN X-BAND SYSTEM FOR DIAGNOSTICS DURING PULSED MICROWAVE BREAKDOWN OF A SHOCK GENERATED PLASMA
James C. Blackburn and Frank L. Tevelow Jun. 1970 29 p refs
(AD-712974; HDL-TR-1504) Avail: NTIS CSCL 20/9

The report describes the circuits, equipment, and experimental approach used for analysis of breakdown resulting from a high-power, X-band microwave pulse incident on a shock-produced plasma. The shock-ionized gas passes through a test section where it is simultaneously heated by a pulse at 9.58 GHz and probed by a low-power CW signal at 9.385 GHz. Breakdown is observed by recording the incident, transmitted and reflected amplitudes of the heating pulse, and through bridge analysis of the diagnostic signal. A description is also given of electric-field probes used to determine the instantaneous field configuration in the test section during breakdown. As this report is concerned specifically with the equipment and measurement techniques employed in investigating the breakdown problem, detailed test results will be presented in a subsequent report. Author (TAB)

N71-13341# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
HOT IONS AND DIFFERENTIAL ROTATION IN A NON-MAXWELLIAN PLASMA WITH A STATIC PARALLEL ELECTRIC FIELD
N. Hopfgarten, R. B. Johansson, B. H. Nilsson, and H. Persson Sep. 1970 6 p refs Presented at the 4th Europ. Conf. on Controlled Fusion and Plasma Phys., Rome, 31 Aug. – 4 Sep. 1970
(Rept-70-27) Avail: NTIS

Energetic ions of a Penning discharge in a strongly inhomogeneous magnetic mirror field were investigated. The measurements suggest a fast rotational drift with violation of the isorotation law and non-Maxwellian velocity distributions. An explanation involving both parallel and transverse electric fields is proposed. In one of the mirror regions a shock-like structure was observed. Author (ESRO)

N71-13368# Aerospace Corp., El Segundo, Calif. Lab. Operations.
AN ACCELERATION MECHANISM FOR NEUTRON PRODUCTION IN z-PINCH DISCHARGES
Melvin J. Bernstein 21 Aug. 1970 32 p refs
(Contract F04701-70-C-0059)
(AD-712692; TR-0059(6220-50)-1; SAMSO-TR-70-365) Avail: NTIS CSCL 20/9

A model was developed for the acceleration of deuterons in the tightly compressed column of a z-pinch discharge, in particular that of a plasma focus discharge. It was assumed that an annular current distribution, undergoes a rapidly contracting transition to an axially peaked distribution and the resulting crossed fields, B sub theta and E sub z, were used to calculate deuteron trajectories in the plasma. The results show how a significant number of ions can be accelerated to high energies and that they have a large value for their time-averaged axial velocities. The orbiting motion in the magnetic field produces an anisotropy distribution of collision velocities, and a neutron-production model based upon nuclear collisions by these deuterons accounts for the measured characteristics of neutron energies, neutron fluxes, and rates of neutron production. Author

N71-13389# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ELECTROSTATIC INSTABILITIES IN MULTICOMPONENT PLASMAS
Michael Schulz and Harry C. Koons 15 Aug. 1970 13 p refs
(Contract F04701-70-C-0059)
(AD-712690; TR-0059(6260-20)-9; SAMSO-TR-70-362) Avail: NTIS CSCL 20/9

A commonly employed heuristic method for evaluating phase velocities and growth rates of ion and electron plasma oscillations is generalized to multicomponent plasmas. The new formulation exhibits the correct Galilean transformation properties. Author (TAB)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 18 Masers. For related information see also: 10 Electronics.

N71-12417*# Techtran Corp., Glen Burnie, Md.
THE MODULI OF ELASTICITY OF PYRITE [MODULI UPRUGOSTI PIRITA]
K. S. Aleksandrov et al Washington NASA Dec. 1970 8 p refs Transl. into ENGLISH from Izv. Sibirsk. Otd. Akad. Nauk SSSR (USSR), no. 6, 1961 p 43 – 47
(Contract NASw-2037)
(NASA-TT-F-13406) Avail: NTIS CSCL 13M

Noting that earlier investigators have found negative values for the modulus of elasticity in pyrite crystals, the results are checked through further and more precise measurements on two perfect test samples of pyrite single crystals. It is concluded that reliable data have not yet been presented to show that the Poisson coefficient is negative, although this would not be contrary to theory. Earlier results referred to are believed to be the consequence of imprecise measurements, or of errors in computation. Author

N71-12572# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXAMINATION OF TRANSMISSION OF COPPER SULFIDE LAYERS FORMED ON CADMIUM SULFIDE USING CUPROUS CHLORIDE SOLUTIONS
Rose L. Schalla Washington Dec. 1970 17 p refs
(NASA-TM-X-2143; E-5891) Avail: NTIS CSCL 20L

Optical transmission studies were made of copper sulfide barriers formed on CdS films and compared with transmission curves of known copper sulfide. The effect of halide ion concentration in the solution was examined. To form a cuprous sulfide barrier, the cuprous chloride solution must apparently contain a sufficient concentration of a complex ion. A barrier of mixed copper sulfides formed when this concentration was too low. The effects of bath temperature and dip time are very critical to barrier thickness. Prolonged washing of the cell after barrier formation converts some of the barrier to other forms of copper sulfide. Author

N71-12669# California Univ., Livermore. Lawrence Radiation Lab.
DEFORMATION OF CRYSTALS OF ALPHA PLUTONIUM IN COMPRESSION
Robert G. Liptai and Robert J. Friddle (ANL) 11 Jun. 1970 12 p refs Presented at the 4th Intern. Conf. on Plutonium and Other Actinides, Santa Fe, N.Mex. Sponsored by AEC
(UCRL-72507; CONF-701001-3) Avail: NTIS

Large crystals of alpha plutonium (to 2 x 2 x 5 mm) were prepared by high-pressure techniques. The results of a study to identify the deformation mechanisms and the stress-strain characteristics of alpha plutonium at room temperature are reported. All tests were compressive. The slip planes were identified by

two-surface analysis. Slip was the dominant deformation mechanism; however, some evidence suggested that twinning deformations were present. Results showed that several slip planes were operative, apparently depending on the crystallographic direction of strain. Although most samples revealed only one slip plane, three planes were noted in one compression sample. Plastic deformation was usually less than 1%; but in one case, deformation was over 13%. Most samples taken to failure exhibited brittle fracture. Author (NSA)

N71-12670*# Translation Consultants, Ltd., Arlington, Va.
SOME THERMODYNAMIC CONSTANTS OF ALKALI METANIOBATES AND METATANTALATES [O NEKOTORYKH TERMODINAMICHESKIKH KONSTANTAKH METANIOBATOV I METATANTALOV SACHELOCHNYKH METALLOV]
A. V. Lapitskiy et al Washington NASA Dec. 1970 5 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 2: Khim. (Moscow), v. 15, no. 4, 1960 p 25–27
(Contract NASw-2038)
(NASA-TT-F-13421) Avail: NTIS CSCL 20L

A method for computing the radii of NbO(−)3 and TaO(−)3 ions using data on the solubility of alkali metaniobates and metatantalates is discussed, and the results are tabulated. Author

N71-12671# Missouri Univ., Rolla. Graduate Center for Materials.
FERROELECTRIC PROPERTIES OF BISMUTH FERRATE AND RELATED MATERIALS Final Report
Robert Gerson and William J. James Jun. 1970 65 p refs
(PB-192909; COO-1368-12) Avail: NTIS CSCL 20B

Techniques were developed for the preparation of the perovskite-type compound Bi FeO3, both as a powder and in small (1 mm) single crystals. The structure of Bi FeO3 was then determined. It is ferroelectric and the space group to which it belongs, R3c, permits weak ferromagnetism, opening the possibility for the use of the interaction of electric and magnetic ordering in the material. The structure of the low temperature phase of rhombohedral lead titanate zirconate has been found to be similar to that of Bi FeO3. Both structures involve a rotation of oxygen octahedra about a <111> axis. Ferroelectric properties were investigated in the system Bi FeO3-PbZrO3. While high Curie points were found in this system, other properties of the materials make their application as piezoelectrics unlikely. Author (USGRDR)

N71-12672# Sandia Corp., Albuquerque, N.Mex.
RADIATION GENERATED WAVE PROPAGATION IN ELASTIC NONCONDUCTORS
Jace W. Nunziato Jun. 1970 23 p refs Sponsored in part by AEC
(SC-RR-70-428) Avail: NTIS

The problem of a nonconducting elastic half-space subjected to a transient radiation field characteristic of a laser source is solved using the coupled theory of linearized thermoelasticity and integral transform techniques. A nondimensional WONDY 3 calculation of the stress histories at the penetration depth and four times the penetration depth is found to be in very good agreement with the exact coupled-theory solution. Author (NSA)

N71-12753# Westinghouse Research Labs., Pittsburgh, Pa.
GEISHA SEMICONDUCTOR RELIABILITY STUDIES. PORTION OF CHAIR-GEISHA Semiannual Technical Report, 1 Feb.–31 Jul. 1970
John R. Szedon and Karl K. Yu 29 Sep. 1970 24 p
(Contract N00014-70-C-0230)
(AD-712551; SATR-1) Avail: NTIS CSCL 20/12

Gate controlled diodes were fabricated with silicon dioxide and silicon nitride for the gate insulators. Total leakage current in these diodes was resolved into three components: the bulk current, the surface generation current and the field-induced surface junction current. Investigation shows that the intrinsic carrier concentration controls the temperature dependence of the magnitudes of these current components as expected. Actual GEISHA target design has been completed. Worst case analysis of the target, based on the results obtained from the gate controlled diodes, predicts maximum leakage current of less than 300 microamperes at 150C and 200 V reverse bias, using non-epitaxial material. Preliminary irradiations were performed on gate-controlled diodes with thermal oxide gates. Polyimide coated units show no net charge buildup in the insulators after irradiation. The coated units also show less surface leakage current than the non-coated units both before and after irradiation. These results indicate that the inorganic coating is suitable for radiation passivation, if compatible with the rest of the system. Author (TAB)

N71-12754# Hamburg Univ. (West Germany). Mineralogisch-Petrographisches Inst.
RELATIONS BETWEEN CRYSTAL INDEX SURFACE AND MOLECULAR AND CRYSTAL STRUCTURE [BEZIEHUNGEN DER INDEXFLAECHE ZUM MOLEKUELBAU UND ZUR KRISTALLSTRUKTUR]
Ruediger Klar (Ph.D. Thesis) 1970 77 p refs In GERMAN
Avail: NTIS

A survey is given of the theories concerning relations between crystal index surfaces and molecular and lattice structures. The theory of Ewald and Born is used as a basis for calculation of refractivity, molecular refraction, cell parameters of atoms, and optical activity. To this end the theory is newly derived in order to deduce the lattice influence on light refraction as Lorentz factor matrices. A FORTRAN program is written to accomplish this. A second FORTRAN program is used to compute the index surfaces of molecular crystals such as benzene. ESRO

N71-12755# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.
CRYSTALLIZATION IN MAGNETIC AND ELECTRIC FIELDS Final Technical Report, Jan.–Dec. 1969
M. Schieber, M. Hanani, and S. Kravamy 28 Dec. 1969 19 p refs
(Contract DAJA-37-69-C-0534)
(AD-704356) Avail: NTIS CSCL 20/2

The kinetics of crystal growth on a seed in solutions has been studied for the antiferromagnetic water soluble crystal Cu(CH3000)2H2O I around 1-2C and the rate of growth and dissolution has been investigated for the ferroelectric Rochelle salt crystal NaK C2H4O2(COO)2.4 H2O II around 19 and 24C. The antiferromagnetic Neel point T(N) of I is 7C and the ferroelectric Curie temperature T(c) of II is 24C. The growth of crystals I has been performed also in high magnetic fields up to 142 KOe. Two crystals of I, one outside and the other inside the high magnetic field have been investigated. The isothermal rate of growth inside the field has been at a temperature about 0.3C higher than outside the field. Author (TAB)

N71-12803# Illinois Univ., Urbana.
AN ELASTIC STUDY OF DIVACANCY DAMPING IN GOLD
David Griffitt Franklin, III Jun. 1970 64 p refs
(Contract AT(11-1)-1198)
(COO-1198-725) Avail: NTIS

The frequency dependence of the damping peak due to divacancy damping in high purity quenched gold was measured. The annealing characteristics of both the divacancy damping peak and the background damping were also investigated. The results of the frequency dependence of the damping peak are discussed in terms of a divacancy rotating in the lattice with an energy of motion of 0.65eV. The results of the annealing study of the damping peak are interpreted as single vacancies coming together to form divacancies giving an initial increase in the divacancy concentration. The divacancies then migrate to sinks causing the divacancy damping peak to disappear. The annealing of the

background damping is interpreted in terms of divacancies migrating to dislocations and pinning them. Analysis of this annealing yields a long range energy of motion which is consistent with the rotational energy of motion measured. An analysis of the annealing of the divacancy damping peak and its height also indicates that a divacancy is tightly bound and has a large dipole anisotropy strength. NSA

N71-12804# Owens-Illinois Glass Co., Toledo, Ohio.
NUCLEATION PHENOMENA IN GLASS-CERAMIC MATERIALS Final Scientific Report
George F. Neilson 30 Apr. 1970 18 p refs
(Contract AF 49(638)-1701)
(AD-712094; AFOSR-70-2397TR) Avail: NTIS CSCL 20/2

The primary objective of the research was to obtain a more thorough understanding of the mechanisms and kinetics of nucleation, phase separation, and crystallization in glass-ceramic materials. Small-angle x-ray scattering was employed as the principal investigative technique, with the specimen preparation and instrumental techniques developed so as to allow quantitative scattering data to be obtained from phase separated glasses. Also, interpretive procedures to allow analyses of these data in terms of the above objective were developed. The kinetics of phase separation, particle growth, and crystallization in a glass-ceramic material containing ZrO2 as nucleant was studied at various temperatures by means of small-angle x-ray scattering, electron microscopy, and x-ray diffraction. It was found that a particle plus diffusion depletion zone model was adequate for analysis of the scattering data at low temperatures. In a study of amorphous phase separation in various Na2L.Si2 glasses the kinetics of both the early and later stages of phase separation were investigated with glass composition, heating temperature, and initial state of the glass as experimental parameters. However, agreement with various aspects predicted from the theory of spinodal decomposition was obtained, and it was possible to define several parameters measurable from scattering experiments which assist in the recognition of this particular mechanism. Author (TAB)

N71-12834# Florida Univ., Gainesville. Dept. of Electrical Engineering.
A CENTER OF COMPETENCE IN SOLID STATE MATERIALS AND DEVICES
Fred A. Lindholm, Arthur J. Brodersen, Eugene R. Chenette, Robert W. Gould, and Larry L. Hench 10 Mar. 1970 211 p refs
(Contract F19628-68-C-0058; ARPA Order 1060)
(AD-711848; AFCRL-70-0284; SR-5) Avail: NTIS CSCL 20/12

The report describes technical findings in four main subject areas: semiconductors and semiconductor devices, insulating and semiconducting glasses, measurement techniques, and magnetic materials. Author (TAB)

N71-12835# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
AMORPHOUS CARBON FILMS: CONDUCTION ACROSS METAL/CARBON/METAL SANDWICHES
Margaret L. A. Mac Vicar 24 Sep. 1970 20 p refs
(Contract N00014-67-A-0204-0041)
(AD-712073; TR-4) Avail: NTIS CSCL 20/3

Very thin films of evaporated carbon were deposited on various metallic thin film and single crystal substrates to form metal-carbon-metal sandwiches. Electrical conductivity measurements through the carbon, over a range of temperatures from room temperature to below 1K, show that conduction is a complicated process of mechanisms dependent on the presence of both structural and impurity defects. At low temperatures, conductivity appears to be independent of temperature, and the carbon films may act as tunneling barriers of effective heights 30 - 100 meV. These heights can be engineered by suitable choices of evaporation and substrate conditions. Any explanation of conduction in these films remains speculative at best. Author (TAB)

N71-12838# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
TUNNELING INTO SUPERCONDUCTING RHENIUM SINGLE CRYSTALS
Shin I. Ochiai, Margaret L. A. Mac Vicar, and Robert M. Rose 24 Sep. 1970 14 p refs
(Contract N00014-67-A-0204-0041)
(AD-711826; TR-2) Avail: NTIS CSCL 20/12

Tunneling into rhenium single crystals amorphous carbon barriers was used to measure the dependence of the energy gap on temperature, orientation and magnetic field. Both gap and gap anisotropy were different for the cases of data from single-particle and double-particle events, respectively, indicating the importance of selection rules. Field and temperature dependences were those of a classified Type I BCS-type superconductor. Comparison with Fermi surface and phonon spectrum anisotropies indicate that for Re phonon effects dominate, in contrast to the case of Nb. Author (TAB)

N71-12837*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETIC SUSCEPTIBILITIES OF SEVERAL RARE EARTH SELENIDES AND TELLURIDES
D. E. Hegland and D. R. Behrendt Nov. 1970 17 p refs
(NASA-TM-X-52921) Avail: NTIS CSCL 20L

The magnetic susceptibilities of monoselenides of Gd, Nd, Ce, Yb, and Sm and monotellurides of Yb, Ce, and Sm and GdTe2 have been measured at temperatures from 2 to 300 K in applied magnetic fields up to 3.4 T. With the exception of GdTe2 all were found to have negative paramagnetic Curie temperatures indicative of antiferromagnetic ordering. Spontaneous magnetization was observed in CeSe at and below 4 K. The effective magnetic moment per atom agrees in most cases with that calculated for the tripositive rare earth ion. Author

N71-12839# North Carolina State Univ., Raleigh.
ON UNIQUENESS AND CONVERGENCE OF A DISCRETE AGGREGATE MODEL IN POLYCRYSTALLINE PLASTICITY Technical Report, 1 Sep. 1967 - 31 Aug. 1973
Kerry S. Havner Sep. 1970 25 p refs
(Contract N00014-68-A-0187; Proj. Dynamic Material Response)
(AD-712060; TR-70-5) Avail: NTIS CSCL 20/11

A discrete model for the study of small deformation response of polycrystalline aggregates is presented and analytically investigated. The model encompasses both anisotropic crystal elasticity and a general hardening law over crystallographic slip systems. Internal fields which satisfy the discrete governing equations are established as unique, and a strict proof of convergence to the solution of the corresponding continuum boundary value problem is given. Thus, the model is rigorously confirmed as a rational approximation well-suited to quantitative analyses of aggregate behavior. Author (TAB)

N71-12839# Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science.
NON-BASAL SLIP IN ALUMINUM OXIDE (Al2 O3)
A. H. Heuer, R. F. Firestone, and J. D. Snow Sep. 1970 9 p refs Presented at the 2d Intern. Conf. on the Strength of Metals and Alloys, Pacific Grove, Calif., 30 Aug. - 4 Sep. 1970 Submitted for publication
(Contract N00014-67-A-0404-0003)
(AD-711824, TR-2) Avail: NTIS CSCL 20/2

The occurrence of non-basal slip in both alumina single crystals and polycrystals following deformation at high temperatures and pressures is reported. Author (TAB)

N71-12840# Oak Ridge National Lab., Tenn.
ARC-FUSION GROWTH AND CHARACTERIZATION OF HIGH-PURITY MgO CRYSTALS
C. T. Butler, B. J. Sturm, and R. B. Quincy, Jr. Jun. 1970 46 p refs

(Contract W-7405-eng-26)
(ORNL-4547) Avail: NTIS

Large single crystals of MgO having higher purity than any previously available have been grown. Optical opacity, a severe problem in pure MgO crystals, has been greatly reduced by sweeping the melt with a gas during fusion. A special procedure which reduces both the amount of starting material required for each run, and the chance of accidental contamination of runs using expensive or rare dopants is described. Probable reactions occurring in the region of the arc are discussed. Other methods of producing purer or clearer crystals have been investigated and are described. NSA

N71-12845# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
ON THE FORMATION OF THE 15R TYPE IN THE beta-alpha TRANSFORMATION OF SiC
Yoshizo Inomata et al Bedford, Mass. AFCRL 13 Jul. 1970 20 p refs Transl. into ENGLISH from Yogyo Kyokai Shi (Tokyo), v. 77, no. 9, 1969 p 313–318
(Contract F19628-68-C-0251)
(AD-712021; AFCRL-70-0405; Trans-82) Avail: NTIS CSCL 20/2

The transformation of high-purity beta-SiC to alpha-SiC was studied experimentally in the temperature range from 2100C to 2300C. TAB

N71-12908# National Science Foundation, Washington, D.C.
DIFFUSION OF METALS IN SOLID STATE DEPENDING ON LATTICE PARAMETER AND MELTING POINT OF METALS [DIFFUZIYA METALOV V TVERDOM SOSTOYANII V ZAVISIMOSTI OT PARAMETRA RESHETKI I TEMPERATURY PLAVLENIYA METALLOV]
N. F. Lashko et al 1970 5 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 8, no. 4, 1936 p 597–599
(TT-70-57027) Avail: NTIS CSCL 20L

The diffusion of metals in the solid state as affected by crystal lattice structure and melting point of metals is discussed. The dependence of the diffusion coefficient on the minimum distance between atoms in a crystal lattice and melting points are described. It is shown that the movement of diffusing particles is not in a forward motion in one particular direction. The diffusing particles have a disorderly movement and methods of statistical analysis are used in determining the conditions. Author

N71-12909# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
POLYTYPES OF SiC CRYSTALS GROWN FROM MOLTEN SILICON
Yoshizo Inomata et al 19 Aug. 1970 19 p refs Transl. into ENGLISH from Yogyo Kyokai Shi (Tokyo), v. 77, no. 3, 1969 p 83–88
(Contract F19628-68-C-0251)
(AD-712022; EMM-69-250; AFCRL-70-0492; AFCRL-TRANS-83) Avail: NTIS CSCL 20/2

The relationship between the polytypes of SiC and the supersaturation of the solution has been studied at 1800C with the synthetic method using molten silicon. TAB

N71-12914# National Science Foundation, Washington, D.C.
THE PROBLEM OF FORCED DIFFUSION IN A REGION WITH A MOVING BOUNDARY [OBODNOI ZADACHE VYNUZHDENNOI DIFFUZII V OBLASTI S PODVIZHNOI GRANITSEI]
E. M. Kartashov et al 1970 19 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), v. 10, no. 7, 1967
(TT-70-57057) Avail: NTIS CSCL 20L

The boundary value problem of the equation forced diffusion in semi-infinite region with mobile boundary was solved by taking into account the dependence of the coefficient of mass transfer on time. The solution to the problem was obtained in the form of an alternating Leibniz-type of series, which is convenient for numerical calculations. Author (USGRDR)

N71-12915# Cornell Univ., New York. Materials Science Center.
AN EQUATION OF STATE FOR SOLID HYDROGEN
Thomas Alexander Bruce (M.S. Thesis) Jan. 1970 24 p refs
(Contract AT(30-1)-3699)
(NYO-3699-43; Rept-1297) Avail: NTIS

An equation of state for solid hydrogen for a range in pressure of 0 to 112 k-bar is presented. An estimate of the degree of uncertainty in the energy can be made by noting that with two Monte Carlo runs at the same values of the parameters A and B but starting from two different initial particle configurations, energies which may vary by as much as 2–3 deg are obtained. The overall uncertainty in the equation of state for the Lennard-Jones potential is less than 2%. At high pressures, the deviation from the experimental data is very large for the Lennard-Jones potential. It is apparent that the repulsive part of the potential for high densities is much too strong and that only a qualitative understanding of the equation of state in this area can be derived. Author

N71-12973# Sandia Corp., Albuquerque, N.Mex.
MEASUREMENT OF SPUTTERING YIELDS IN ION IMPLANTATION SYSTEMS
E. P. Eernisse Jun. 1970 26 p refs
(SC-RR-70-377) Avail: NTIS

An accurate and fast quartz resonator microbalance method has been developed for measuring sputtering yeilds of materials being bombarded in ion implantation systems. Data obtained by the method for vapor deposited polycrystalline copper bombarded by krypton ions are presented and compared with past results. The importance of background reactive gas pressures and ion current density in determining meaningful sputtering yields is demonstrated with the data. Author

N71-12988# Connecticut Univ., Storrs.
ELECTRICAL AND THERMAL PROPERTIES OF IMPURE, SINGLE CRYSTALS OF SUPERCONDUCTORS Final Report, 1 Nov. 1966–30 Apr. 1970
Charles A. Reynolds 19 Aug. 1970 14 p refs
(Contract N00014-68-C-0491; Grants AF-AFOSR-0474-67; AF-AFOSR-0474-64)
(AD-712411; AFOSR 70-2231TR) Avail: NTIS CSCL 20/12

The effect of crystal orientation and type and amount of impurities on the electrical resistivity, thermal conductivity and superconductivity transition curve of tin and indium has been investigated. The electrical resistance of tin samples with cadmium, antimony, indium and zinc impurities has been measured as a function of impurity content at 373K, 273K, 77K and 4.2K. The change in anisotropy with impurity type is explained on the basis of a theory of Klemens. Lately some samples have been measured over the continuous range from 4.2K to 77K and some interesting effects found. The effect of the above mentioned impurities on the superconducting transition curve of tin has been found and agreement with the theory of them has been demonstrated. Also studied was the thermal and electrical conductivities of dilute Au:Fe, and the lattice thermal conductivity of Cu:Al. Author (TAB)

N71-12989# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
NUCLEATION AND GROWTH IN A MIXED CRYSTAL SUSPENSION Final Report
M. A. Larson Feb. 1970 10 p refs
(Grant NSF GK-1328)
(PB-189374; ISU-ERI-AMES-68700) Avail: NTIS CSCL 20B

A small laboratory, continuous mixed suspension, mixed product removal crystallizer was used to measure the crystal growth and nucleation rates of various systems under varying

conditions. Simple power models relating the kinetics to supersaturation were determined for several potassium salts. The effect of temperature level and of additives was determined. In related work the effects of classification at the point of withdrawal were examined. Similar determinations were made with a small evaporative batch crystallizer. Author (USGRDR)

N71-12990# Bendix Corp., Southfield, Mich. Research Labs.
DEVELOPMENT OF LIQUID CRYSTAL MICROWAVE POWER DENSITY METER, 1 JULY–30 NOVEMBER 1969
Rockville, Md. PHS May 1970 24 p refs
(Contract PHS-CPE-R-69-28)
(PB-191396; BRH/DEP-70-8) Avail: NTIS CSCL 14B

Developed was a liquid crystal microwave power density meter. The meter has a Mylar membrane with resistive and liquid crystal coatings which serves as a large-area sensing element and uses direct current electrical power for bias and calibration of the membrane. The general operating principles of such an instrument and the design and operating characteristics of the particular meter constructed are described in the report. Author (USGRDR)

N71-13057*# Radio Corp. of America, Princeton, N.J.
DEVELOPMENT OF GaAs AN GaAs(1-x)P(x) THIN-FILM BIPOLAR TRANSISTORS Final Report
C. J. Nuese and R. H. Dean Nov. 1970 40 p refs
(Contract NAS12-2091)
(NASA-CR-111805) Avail: NTIS CSCL 20L

A study of several parameters which limit the current gain of GaAs bipolar transistors has led to the development of vapor grown n-p-n GaAs transistors with reproducible stable current gains as high as 30 at room temperature and 15 at 300 C. These transistors have nearly flat I-V characteristics to voltages greater than 50 V. The technology by which such transistors were fabricated utilizes a chemical etch of NaOH:H2O2 to expose portions of the middle (base) layer of a three layered vapor grown structure for contacting. With a post fabrication HCl surface treatment transistor gains were increased to values as high as 90, although these exceptionally high gains degrade to their pretreated values in about an hour due to the reversion of the GaAs surface to its pretreated condition. Author

N71-13066*# Texas Univ., Austin. Solid State Electronics Research Lab.
ANALYSIS OF LOW TEMPERATURE TRAPPING AND RECOMBINATION IN II-VI COMPOUNDS USING PHOTODIELECTRIC TECHNIQUES
James J. Hinds and William H. Hartwig 19 Jun. 1970 158 p refs
(Grants NGR-44-012-104; AF-AFOSR-1792-69)
(NASA-CR-111562; TR-90) Avail: NTIS CSCL 20L

In II-VI compounds at cryogenic temperatures, the photodielectric (PD) effect is the result of optically-induced changes in the densities of free and trapped carriers. Changes in both the real and imaginary parts of the complex dielectric constant are observable when the semiconductor is placed in a superconducting microwave cavity and irradiated with light. A change in the real part of the dielectric constant results in a sizeable change in the cavity resonant frequency, while a change in the imaginary part of the dielectric constant produces a change in the microwave power absorbed by the semiconductor. Equations are presented which relate the frequency change and power absorption change to the density of free carriers. The PD technique gives a direct measurement of both the free carrier density and the trapped carrier density. Author

N71-13067# Naval Research Lab., Washington, D.C.
THE CONDITIONAL PROBABILITY DISTRIBUTION OF CRYSTAL STRUCTURE INVARIANTS Final Report
Janet E. Fisher, J. Harrison Hancock, and Herbert A. Hauptman 31 Jul. 1970 45 p refs
(AD-712787; NRL-7132) Avail: NTIS CSCL 20/12

New methods for solving complex noncentrosymmetric crystal structures have been developed at NRL. A vital part of the method involves evaluating the structure invariants cos(phi(sub vector h(sub 1)) + phi (sub vector h (sub 2)) + phi (sub vector h (sub 3))), where vectors ((h sub 1) + (h sub 2) + (h sub 3)) = 0, directly from the normalized structure factor amplitudes. The theoretical conditional probability distribution of cos(phi(sub vector h (sub 1)) + phi (sub vector h (sub 2)) + phi (sub vector h (sub 3))) and the theoretical expected values of the structure invariants are essential to this computation. This report tabulates the conditional distribution and the expectations. Author (TAB)

N71-13068*# Texas Univ., Austin. Solid State Electronics Research Lab.
VAPOR DEPOSITED TITANIUM DIOXIDE THIN FILMS: SOME PROPERTIES AS A FUNCTION OF CRYSTALLINE PHASE
Eugene T. Fitzgibbons and William H. Hartwig 15 Apr. 1970 154 p refs
(Grants NGL-44-012-043; AF-AFOSR-1792-69)
(NASA-CR-111559; TR-86) Avail: NTIS CSCL 20L

Thin films of TiO2 are grown in a low temperature (150 C) vapor deposition process by hydrolyzing tetraisopropyl titanate at the substrate. Annealing in air at 350 C converts the film to the anatase tetragonal crystalline form and at 700 C to a mixture of anatase and rutile. Both forms are quite etch resistant, but the anitase can be etched by HF and warm H2SO4. At 1000 C, the film is completely rutile. This form is extremely etch resistant. The conversion from amorphous to rutile is accompanied by a thickness decrease of 36%. Electrically, the amorphous material was found to be semiconducting and subject to forming in an electric field. The anatase form showed a mixture of properties depending on the frequency used. The mixed and rutile forms both are insulators with dielectric constants/dissipation factors of 116/.04 and 100/.04, respectively, at 1 kHz. Combinations of TiO2 and SiO2 were made in which the sign and density of the surface states could be varied. Rutile films were tested as a diffusion mask against phosphorous at 1000 C. It was shown that, in that particular case TiO2 is a more effective mask than an equal thickness of SiO2. Author

N71-13069*# Linfield Research Inst., McMinnville, Oreg.
SINGLE CRYSTAL SURFACE WORK FUNCTION AND DESORPTION STUDIES Final Report
L. W. Swanson and R. W. Strayer 31 Oct. 1970 55 p refs
(Grant NGR-38-010-001)
(NASA-CR-111564) Avail: NTIS CSCL 20L

Using the field emission retarding potential method true work functions have been measured for the following substrates: Cu(100), phi sub C = 5.10; W(111), phi sub c = 4.47; Ir(111), phi sub c = 5.76 eV. The electron reflection coefficients from these surfaces were also examined near zero volts. Preliminary measurements of sticking coefficients and desorption characteristics were measured for cesium on 110 W. The results indicate a sticking coefficient of unity at a substrate temperature of 77 K for monolayer coverages. Evidence of discrete adsorption states along with continuous variation of binding energy with coverage is indicated by our thermal desorption results. Author

N71-13178# Stanford Univ., Calif. Microwave Lab.
QUANTUM THEORY Final Report, 1 Jul. 1969–30 Jun. 1970
Walter A. Harrison Jul. 1970 6 p
(Contract N00014-67-A-0112-0035)
(AD-712486; ML-1882) Avail: NTIS CSCL 20/12

Effects of anisotropies in electron scattering, particularly in scattering by phonons, have been explored. The effects on low temperature resistivity have been found to be pronounced. Similar large effects are expected for galvano-magnetic properties and cyclotron-mass enhancement due to electron-phonon interactions. In

an unrelated study the first application of the pseudopotential method to a purely classical problem has been made. This was a study of sound waves in crystals containing localized modes. Author (TAB)

N71-13177# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE RECTIFYING PROPERTIES OF AN ANTIMONY-ANTIMONY SELENIDE DIFFUSED JUNCTION

N. N. Koren et al 28 May 1970 8 p refs Transl. into ENGLISH from Akad. Navuk BSSR (Minsk), v. 13, no. 7, 1969 p 595-596
(AD-712941; FTD-HT-23-280-70) Avail: NTIS CSCL 20/12

The rectifying properties were studied for a junction prepared by the reactive diffusion of Se from the vapor phase into the Sb. An analysis of the v amp. characteristic shows that as the thickness of the Sb_2Se_3 layer increases, the slope of the linear segment in the transmission direction decreases; the right branch shifts to the right, which corresponds to a lower value of the d.c. at the given voltage. The low values of the d.c. (10-20 ma.) and the smoother increase in the d.c. with increasing voltage are due to the large resistance of the vol. of the semiconducting film. For low voltages, the d.c. increases exponentially with the applied voltage. The rectification coefficient depends on the layer thickness, and is 1000 to 10,000 for a 3-5 micrometer film. Author (TAB)

N71-13196# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENERGY STRUCTURE OF ZONES AND EXCITONS

V. V. Sobolev 19 Jun. 1970 18 p refs Transl. into ENGLISH from the Publ. 'Issledovaniya Fizicheskikh Svoystv Poluprovodnykovykh Materialov i Drugikh Kristallov' Kishinev, Izd-Vo Kartva Moldovenyaske, 1965 p 85-93
(AD-712812; FTD-HT-23-279-70) Avail: NTIS CSCL 20/12

To better understand the properties of solid bodies, one must understand the zone theory. Basic assumptions of the zone theory are: the many-body problem is reduced to a single-electron problem, changes in the balanced configuration of the nuclei are disregarded, the requirement imposed on the totality of electrons by Fermi statistics are not considered in the equation of electron interaction. Two basic results of the quantum-mechanical calculation are: (1) the valence electron does not belong to a specific lattice point and can be found at any lattice point with equal probability; electrons of the inner shells are fixed in the lattice points just as in isolated atoms; (2) the electron levels of atoms in the crystal expand into quasi-continuous zones; zones are formed due to the well-known quantum-mechanical conclusion about the connection between energy uncertainty and life span of a given electron. For a given crystal valence electron; for this reason, the width of the zone of possible energies of the electron is given. The minimum magnitude of energy required to transfer an electron from the highest filled band to the lowest free zone is known as the energy of a given forbidden zone. Author (TAB)

N71-13221# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROPERTIES OF p-n JUNCTIONS IN CADMIUM SULFIDE AND CONSTRUCTION OF PHOTOELECTRIC TRANSDUCERS

Stefan Knev et al 24 Jun. 1970 13 p refs Transl. into ENGLISH from Izv. Fiz. Inst. Aneb., Bulg. Akad. Nauk. (Bulgaria), v. 17, 1968 p 13-20
(AD-712936; FTD-HC-23-133-70) Avail: NTIS CSCL 20/12

The development of efficient photoelectric converters based on CdS is described. The photoelectric p-n junctions were made as follows: Cadmium sulfide powder was pressed into small tablets under a pressure of several hundred kilograms per cm(superscript 2). The tablets were baked for 15 min under closely controlled conditions to form pure monocrystals (size, up to 50 mu) on one side of the tablet, i.e., to form the working surface of the converter. This working surface was then immersed for several seconds in a boiling, saturated water solution of copper sulfate to cover it with a thin coating which contained p-type carriers and was presumed to be formed by the chemical reaction given. The coated tablet was then heated at a temperature of 350 degrees centigrade for about 20 sec. The converter was completed by depositing electrodes on both sides of the tablet. Efficiencies of the order of 8 percent were obtained with the described photoelectric converters. Author (TAB)

N71-13223# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

PATTERNS OF MAGNETIC FLUX PENETRATION IN SUPERCONDUCTING FILMS

Robert N. Goren Jan. 1970 206 p refs
(Contracts N00014-67-A-0298-0022; ARPA SD-88; Grant NSF GP-11392)
(AD-703658; TR-2) Avail: NTIS CSCL 20/3

Patterns of magnetic flux penetration have been observed in thin superconducting films of tin, lead, and indium in perpendicular applied fields of 0.1 - 100 Oe. The flux patterns were studied by measuring the magnetic field very close to the film with a high resolution Hall probe which could be scanned in a plane parallel to the surface of the film. The observed patterns appear to contain both laminar and round normal regions. Using Landaus theory of the intermediate state as a guide, a similar model is considered in which the flux pattern consists of normal spots, rather than laminae. Within the accuracy of an approximate calculation, the free energy of both models is roughly the same in low fields, which implies that both spots and laminae can exist in the intermediate state. The results for the thicker indium samples (1.1 - 6.3 micrometers) are in good agreement with the temperature, field, and thickness dependences of either Landaus laminar model or our spot model for the intermediate state. Author (TAB)

N71-13234# Oregon Univ., Eugene.

RESEARCH IN EXPERIMENTAL AND THEORETICAL PHYSICS Final Report, 27 Jan. 1967-30 Jun. 1970

Kwangjai Park 30 Jun. 1970 48 p refs
(Contract DAHC04-67-C-0030)
(AD-712395; AROD-6948.5-P) Avail: NTIS CSCL 20/11

The band structures of several crystals have been investigated by studying the two-photon absorption process. Author (TAB)

N71-13261# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Mathematik und Physik.

ELECTRON PARAMAGNETIC RESONANCE OF CHROMIUM (3+) AND CHROMIUM (3+)-CHROMIUM (3+) PAIRS IN STRONTIUM TITANATE [ELEKTRONEN-SPIN-RESONANZ AN Cr(3+) UND Cr(3+)-Cr(3+)-PAAREN IN STRONTIUM-TITANAT]

Heinz Dieter Meierling (Ph.D. Thesis) 1969 122 p refs In GERMAN
Avail: NTIS

The electron paramagnetic resonance spectra of chromium (3+) ions in strontium titanate solidified in the cubic phase were measured to study interactions between paramagnetic ions located in neighboring lattice positions. From this, information on their coupling can be obtained, the anisotropic portion of the exchange integral measured, and the influence of the crystal field on the ion pair studied. ESRO

N71-13262# Hamburg Univ. (West Germany). Mathematisch-Naturwissenschaftliche Fakultaet.

INVESTIGATION OF THE ELECTRIC INTERACTION IN EXCITED NUCLEAR LEVELS OF Sn-119 AND Sn-120 [UNTERSUCHUNG DER ELEKTRISCHEN WECHSELWIRKUNG AN ANGEREGTEN KERNNIVEAUS VON Sn-119 UND Sn-120]

Hans-Juergen Wolf (Ph.D. Thesis) 1969 54 p refs In GERMAN
Avail: NTIS

The electric interaction in the 2.3 MeV level of Sn-120 was measured by means of electrostatic disturbances of a gamma-gamma angular correlation. The Moessbauer effect was measured in the different polycrystalline substances at liquid nitrogen temperatures and subsequently the static disturbance of the gamma-gamma angular correlation in the 5 (−) level of Sn-120 was determined at the same field gradient and the same temperature. The extent to which this method can be used to determine the ratio of quadrupole moments is discussed. ESRO

N71-13274# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Research Div.
STACKING FAULT IMAGES AT HIGH VOLTAGES
W. L. Bell Mar. 1970 10 p refs Presented at the 7th Intern. Congr. on Electron Microscopy, Grenoble, France, 30 Aug.–5 Sep. 1970
(Contract W-7405-eng-48)
(PB-192186; UCRL-19199) Avail: NTIS CSCL 20B

Within a few hundred thousand volts either side of the disappearence voltage, a systematic twelve-beam computer program predicts different contrast for high-voltage bright-field images of a stacking fault in a foil oriented for strong second-order Bragg diffraction when the sign of the phase change at the fault is reversed. Author (USGRDR)

N71-13342# Oxford Univ. (England). Clarendon Lab.
HEAT CONDUCTIVITY OF SOLID HELIUM Final Scientific Report, 1 Jul. 1967–30 Jun. 1970
Robert Berman 20 Aug. 1970 7 p refs
(Contract F61052-67-C-0082)
(AD-712729; AFOSR-70-2472TR) Avail: NTIS CSCL 20/12

Thermal conductivity measurements have been made on poly-crystalline specimens of He4-rich and He3-rich mixtures of the two isotopes. Helium was solidified at constant density at pressures up to about 1700 and 1300 atm for the two pure isotopes and to slightly different pressures for mixtures, in order to yield crystals with the same values of Debye characteristic temperature. The results for He4-rich solids have been analysed and indicate that the lattice distortion around a He3 impurity decreases with increasing density. The results on He3-rich solids are at present being analysed. Analysis consists in choosing the form of relaxation rates for phonon scattering by N-processes, U-processes, isotopic impurities and boundaries, so that the measured temperature variation of conductivity of crystals with the same Debye temperature but of different impurity concentrations, can be fitted by varying only the magnitude of the relaxation rate being ascribed to impurities. An apparatus has been built to look for a suggested very great anisotropy in the thermal conductivity of single crystals of He in the hexagonal-close-packed phase. Crystals are grown at constant pressure and the orientation determined optically from the known birefringence. Arrangements have been made for measuring the conductivity of each crystal in two directions at right anges. Author (TAB)

N71-13370# Boeing Scientific Research Labs., Seattle, Wash.
IMPACT IONIZATION, BULK NEGATIVE DIFFERENTIAL CONDUCTIVITY AND OTHER NONEQUILIBRIUM CARRIER PHENOMENA IN InSb
C. L. Dick and B. Ancker-Johnson Sep. 1970 15 p refs
(AD-712484; D1-82-0997) Avail: NTIS CSCL 20/12

The hot electron effect, injection, impact ionization and bulk negative differential conductivity are nonequilibrium carrier phenomena that some semiconductors exhibit. In particular, all four phenomena effect conduction in InSb in a strongly interrelated manner. This work shows the interrelationship of these four nonequilibrium phenomena in InSb and describes two new effects: a temporal and spatial relationship between type-N and type-S bulk negative differential conductivity (BNDC) in n-type InSb and the existence of an impact ionization wavefront which is reponsible for the initiation of this carrier generation mechanism in p-type InSb. These results are presented in two parts: Part I contains a discussion of all these nonequilibrium carrier phenomena in n-type InSb, and Part II treats injection and impact ionization in p-type InSb. Author (TAB)

N71-13381# Harvard Univ., Cambridge. Div. of Engineering and Applied Physics.
MATERIALS SCIENCES PROGRAM, SUMMARY TECHNICAL REPORT
1969 48 p refs
(Contract ARPA SD-88)
(AD-712453) Avail: NTIS CSCL 11/7

The report represents a technical summary of the research activities supported under the ARPA-IDL program during 1969. A list of published papers and technical reports has been included and reprints can be provided upon request. The areas covered are solid state physics, metallurgy, solid mechanics, geological sciences, and chemistry. TAB

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N71-12927*# TRW Systems, Redondo Beach, Calif.
ELECTROSTATIC PROPULSION BEAM DIVERGENCE EFFECTS ON SPACECRAFT SURFACES Quarterly Technical Report, 25 Jul.–23 Oct. 1970
15 Nov. 1970 38 p refs Sponsored by NASA Prepared for JPL
(Contract JPL-952350)
(NASA-CR-111518) Avail: NTIS CSCL 21C

Tolerance-level criteria for the deleterious effects of electrostatic rocket exhaust impinging on typical classes of spacecraft surfaces are discussed. The theoretical optical properties of semitransparent films of typical electrostatic rocket accelerator grid materials are presented. Preliminary results of 3 KeV Hg(+) bombardment of 16 spacecraft surface materials indicate that Teflon FEP has a much higher erosion rate than the other materials tested, including several other organics. Immersion of S13G, PV100, and Z93 white paints in Cs at room temperature for 48 hours had little effect; however 3M Velvet black paint became a mottled gray. Immersion of Kapton in Cs increases its electrical conductivity by at least a factor of 100,000. Author

N71-13070# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va. Fuels Handling Equipment Div.
EFFECTS OF CORROSION INHIBITORS ON THE WATER COALESCING CHARACTERISTICS OF MILITARY STANDARD FILTER/COALESCER ELEMENTS Interim Report
Shirley R. Boulware Sep. 1970 19 p
(AD-712999; USAMERDC-1999) Avail: NTIS CSCL 21/4

The report covers a study of the effects of seven corrosion inhibitors on the coalescing characteristics of the DOD-type filter/coalescer elements used to decontaminate liquid hydrocarbon fuels. These corrosion inhibitors are specified for use in military jet fuels, Specification MIL-I-25017, Inhibitors, Corrosion, Fuel Soluble. The report concludes that: The corrosion inhibitors did not produce any adverse effects on the ability of military standard filter/coalescer elements to remove 1-percent water from JP-5 fuel that had been treated with fullers earth; The free-water content of the fuel passed through the filter/coalescer elements during the 1-percent water injection tests ranged from 0 to 2.0 parts per million (ppm) which is within specification limits; The WSIMs of the inhibited JP-5 fuel

during the tests were between 16 and 70. The low, free-water content did not correlate directly with the relatively low WSIMs; and The WSIM cannot be used solely to determine the ability of a military standard filter/coalescer element to decontaminate inhibited JP-5 after it has been treated with fullers earth. However, the WSIM does give an indication of the ability of a filter/coalescer element to decontaminate uninhibited JP-5. Author (TAB)

N71-13102# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Saturn Development Engineering.

THE RESPONSE OF S-4B LOX TANK CONDITIONS TO VEHICLE PERTURBATIONS

P. W. Garrison and M. L. Joy *In its* Proc. of Low-G Seminar May 1969 p 1-12 refs (See N71-13101 03-31)

Avail: NTIS

Liquid oxygen tank temperature instrumentation indicates that an inverted ullage temperature gradient is established after extended orbital stay times. After vehicle perturbations, the ullage temperatures are observed to approach liquid surface temperatures. It is assumed that the increase in liquid-vapor interface area and the turbulent mixing associated with a slosh wave-baffle interaction result in heat and mass transfer to the vapor phase until equilibrium conditions are achieved. Author

N71-13103# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.

LOW-G BUBBLE BEHAVIOR

R. A. Madsen and J. N. Castle *In its* Proc. of Low-G Seminar May 1969 p 13-24 refs (See N71-13101 03-31)

Avail: NTIS

The calculation of bubble rise velocities in multibubble systems under reduced gravity is discussed. Equations are recommended for calculating the rise velocity of an isolated bubble in reduced gravity. A correlation scheme is derived for the rise velocity in a multibubble system. Dimensionless parameters are defined and various regimes of flow are indicated. Author

N71-13104# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Saturn Aerothermodynamics.

VAPOR VOLUME ENTRAINED IN THE BULK OF THE LIQUID DUE TO BOUNDARY LAYER BOILING IN A LOW-GRAVITY FIELD

J. Navickas and H. R. Melton *In its* Proc. of Low-G Seminar May 1969 p 25-37 refs (See N71-13101 03-31)

Avail: NTIS

The characteristics of vapor volume entrained in liquid due to boundary layer boiling in a low gravity field are discussed. In a low gravity cryogenic storage system, external heating may cause vapor generation at the heated surfaces. For a given heating rate the quantity of vapor generated depends on the rate of heat transfer. The vapor volume located within the liquid depends on the settling acceleration and can be very large for very low acceleration levels. In the limiting cases, all of the vapor is located below the liquid surface with no distinct ullage space in the storage vessel. Author

N71-13105# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Flight Dynamics and Control Section.

SATURN S-4B PROPELLANT BEHAVIOR

R. N. Salzman and J. C. Wood *In its* Proc. of Low-G Seminar May 1969 p 39-49 refs (See N71-13101 03-31)

Avail: NTIS

The behavior of liquid rocket propellants in Saturn launch vehicles is discussed. The vehicle equations of motion include propellant slosh force and moments and the slosh equations of motion are presented. Propellant natural frequencies are assumed to be nonlinear functions of the vehicle axial acceleration. Both fluid viscous damping and baffle damping are considered. The slosh-attitude control system model has been simulated both digitally and on a hybrid computer and is used for launch and earth-coast phases of a flight. Author

N71-13106# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Flight Dynamics and Control Section.

SLOSH WAVE AMPLIFICATION

R. N. Salzman *In its* Proc. of Low-G Seminar May 1969 p 51-61 refs (See N71-13101 03-31)

Avail: NTIS

The motion of liquid surfaces resulting from slosh disturbances is described. Propellant slosh energy is periodically transferred between kinetic and potential energy. Kinetic energy is conserved through thrust cutback, but there is a step drop in potential energy proportional to the acceleration ratio. The results of drop tower tests to simulate slosh amplification resulting from acceleration changes are presented. The adverse effects upon propellant control resulting from fuel sloshing are discussed. Author

N71-13107# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Saturn Development Engineering.

PRESSURIZATION COLLAPSE IN CRYOGENIC PROPELLANT TANKAGE DUE TO SUB-SURFACE VAPOR BUBBLES

R. K. Weegar *In its* Proc. of Low-G Seminar May 1969 p 63-71 refs (See N71-13101 03-31)

Avail: NTIS

Pressurization collapse in cryogenic propellant tankage due to subsurface vapor bubbles is discussed. When the heat flux to a cryogenic saturated propellant is high enough to sustain nucleate boiling at the sidewall, the ullage space will be divided into two parts: (1) a volume enclosed by the tank walls and (2) a large area liquid-vapor interface and column of bubbles produced by the nucleate boiling. If the heat input rates are high and the vehicle acceleration is low, a substantial portion of the ullage will be in the form of bubbles. This phenomenon contributes to the high ullage collapse rates seen during orbital repressurization of liquid fueled rocket stages. Author

N71-13108# McDonnell-Douglas Astronautics Co., Santa Monica, Calif.

A VISUAL STUDY OF PROPELLANT DESTRATIFICATION

F. W. Thomas and L. A. Holmes *In its* Proc. of Low-G Seminar May 1969 p 73-80 ref (See N71-13101 03-31)

Avail: NTIS

Techniques for determining the destratificition of cryogenic fluid propellants are discussed. It is considered that jet mixing is the optimum method to effect destratification. The laboratory equipment used in the investigation and preliminary results obtained are described. Author

N71-13109# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Aero/Thermodynamics and Nuclear Technology Dept.

AN EXPERIMENTAL STUDY OF THE EFFECTS OF LOW BOND NUMBER SLOSHING ON THERMAL STRATIFICATION

L. A. Holmes and R. J. Krane *In its* Proc. of Low-G Seminar May 1969 p 81-99 ref (See N71-13101 03-31)

Avail: NTIS

Thermal stratification of cryogenic liquids is discussed. Thermal stratification is defined as a nonuniform thermal energy distribution along the acceleration axis of a liquid container. The major feature of this distribution is the existence of a layer of liquid near the free surface, which has an average temperature higher than that of the bulk. The impact of stratification is apparent in the design of pressurization and venting systems, tank insulation requirements, and the proper operation of rocket engine turbopumps to prevent cavitation. The effects of low Bond number sloshing on thermal stratification are described. Author

N71-13110# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.

FEASIBILITY OF ROTATIONAL DESTRATIFICATION OF SPACE-STORED LIQUID CRYOGENS

Ivan Catton *In its* Proc. of Low-G Seminar May 1969 p 101–107 refs (See N71-13101 03-31)
Avail: NTIS

The feasibility of rotating a cryogenic storage tank to initiate a convective mixing motion within the liquid cryogen is discussed. Since the ability of the fluid to transfer momentum is equivalent to the ability of the fluid to transfer heat, mixing rates should depend on spin rates in a similar manner. It is estimated that adequate mixing will be achieved by spin rates on the order of one revolution per day. Author

N71-13111# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.
PRESSURIZATION GAS FLOW EFFECTS ON LIQUID INTERFACE INSTABILITY
J. B. Blackmon *In its* Proc. of Low-G Seminar May 1969 p 109–117 refs (See N71-13101 03-31)
Avail: NTIS

Pressurization gas flow effects on liquid interface stability for cryogenic fluids are discussed. The effects of the diffused gas flow on the liquid interface can be modeled and the results applied to vehicles operating in a low gravity environment. The important dimensionless parameters are a modified Froude number and a Kelvin-Helmholtz instability number. Data on the cavity depth and Kelvin-Helmholtz instability correlated well with the dimensionless parameters. Using these dimensionless parameters, the conditions for modeling one-g ground tests are determined. Author

N71-13112# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.
TANK PRESSURIZATION
D. W. Kendle *In its* Proc. of Low-G Seminar May 1969 p 119–134 refs (See N71-13101 03-31)
Avail: NTIS

Interface heat and mass transfer is of critical importance in a low gravity environment because of the increased probability of irregular liquid location and movement. This applies to low gravity pressurization and for low acceleration maneuvering and intermittent thrusting. The heat capacity of the liquid is very large compared to the ullage, and high transfer rates will rapidly and seriously degrade pressurization performance. Performance predictions require a knowledge of the liquid location and movement, the gas flow field, and the interchange between the gas and liquid under these conditions. Author

N71-13113# McDonnell-Douglas Astronautics Co., Santa Monica, Calif.
THERMODYNAMIC VAPOR-LIQUID SEPARATOR
E. C. Cady *In its* Proc. of Low-G Seminar May 1969 p 135–146 refs (See N71-13101 03-31)
Avail: NTIS

The development and characteristics of a thermodynamic vapor-liquid separator are presented. Three systems: (1) wall-mounted, (2) forced convection, and (3) electroconvective are described. Equipment specifications, performance parameters, and fabrication techniques are discussed. Author

N71-13114# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. MOL Flight Systems.
MOL PROPELLANT GAUGING SYSTEM
John Bliss *In its* Proc. of Low-G Seminar May 1969 p 147–153 (See N71-13101 03-31)
Avail: NTIS

A pressure-volume-temperature (PVT) gauging concept for propellant gauging is described. The concept calculates changes in the pressurant remaining in the high pressure assembly of the attitude control and translation system/propulsion system by measuring the pressure and temperature in the pressure bottles. The mass of helium in the propellant tank ullage is then equal to the mass leaving the high pressure spheres, less nominal leakage. Measurement of pressure and temperature in the propellant tank ullage, together with calculated change in mass and estimated ullage composition, is used to calculate a change in ullage volume and propellant volume. Measurement of propellant temperature allows conversion from propellant volume to propellant mass. Author

N71-13115# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Propulsion Dept.
POSITIVE POSITIVE EXPULSION SYSTEMS: A STATE OF THE ART SURVEY
H. M. Hanson and T. J. Schweitzer *In its* Proc. of Low-G Seminar May 1969 p 155–164 ref (See N71-13101 03-31)
Avail: NTIS

The development and characteristics of liquid rocket propellant expulsion systems is described. The types of systems considered are: (1) piston type, (2) bellows type, (3) bladder type, and (4) diaphragm type. The advantages and disadvantages of the several systems are presented. A summary of current industry developments and operating requirements is summarized. Author

N71-13116# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.
PROPELLANT SETTLING
J. B. Blackmon, J. N. Castle, and B. R. Heckman *In its* Proc. of Low-G Seminar May 1969 p 183–195 refs (See N71-13101 03-31)
Avail: NTIS

The phenomena which occur during settling of liquid propellants, such as bubble formation, breakup, coalescence, turbulent dissipation, asymmetric liquid motion and the resulting slosh wave forms, and the effects of baffles are discussed. Methods for determining minimum settling periods, maximum auxiliary propellant requirements, or intermediate conditions are presented. Calculations performed by a numerical program of settling phenomena indicate that proper phasing of two acceleration levels significantly decreases total settling times or total propellant requirements compared with the constant acceleration approach. Author

N71-13119# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.
SURFACE TENSION AND DIELECTROPHORESIS
J. N. Castle *In its* Proc. of Low-G Seminar May 1969 p 197–206 refs (See N71-13101 03-31)
Avail: NTIS

Propellant control techniques using surface tension and dielectrophoresis (DEP) are discussed. Tankage size and vehicle accelerations in current spacecraft exceed the limits of positive expulsion devices or open systems. DEP and surface tension hold the prospect of being inherently reliable because they lack moving parts and are competitive in weight. The use of surface tension control can be considered when surface forces are larger than the inertial and gravitational forces acting on the propellant. DEP is defined as the induced motion of electrically neutral bodies in a nonuniform electric field. Cryogenic propellants are attractive candidates for DEP control because their excellent dielectric properties permit the use of a strong electric field with small accompanying loss due to joule heating. Author

N71-13376# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
INVESTIGATION OF THE FEASIBILITY OF MEASURING THE CHAMBER TEMPERATURE OF SOLID PROPELLANT ROCKET MOTORS BY USING MICROWAVE ATTENUATION MEASUREMENTS
R. G. Olsen and R. W. Grow Jun. 1970 69 p refs
(Contract F44620-68-C-0022; Proj. Themis)
(AD-712703; UTEC-MD-70-095; AFOSR-70-2444TR; TR-TH-2)
Avail: NTIS CSCL 21/9

The analysis of a plane wave propagating through a homogeneous plasma region of dimensions large compared to the signal wavelength has shown that the wave attenuation can be related to physical parameters of the plasma such as electron density, temperature, and pressure. In this report, the plasma in the combustion chamber of a small solid propellant rocket motor is used to investigate the feasibility of determining the temperature of the plasma by using microwave attenuation data. Potassium perchlorate is substituted for some of the ammonium perchlorate in the propellant to give an electron density that produces an easily measurable attenuation. The theoretical results show that for a known propellant composition and potassium perchlorate concentration, both the plasma temperature and chamber pressure at equilibrium may be found from one attenuation measurement. Also, for a known thermodynamic state of the plasma, the electron density may be found from the attenuation data. The method of microwave analysis is shown to be very useful in the study of transient phenomena in that no transducers are required; hence, the time response of the measurement is limited only by the microwave detection circuitry. This technique may be used to study localized disturbances within the plasma region. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N71-12281*# Rocketdyne, Canoga Park, Calif. Dynamics Unit.
ADVANCED FEED SYSTEM COMPONENT INTERACTION ANALYSIS Final Report, 30 Jun. 1969 – 30 Jun. 1970
1 Dec. 1970 277 p refs
(Contract NAS7-749)
(NASA-CR-111612; R-8277) Avail: NTIS CSCL 21H

A generalized method for the dynamic modeling of the pressurization system and the pneumatic pressure regulator in a pressure fed liquid propulsion system is developed. The entire pressurization system is represented by a series of compressible volumes with intermediate restrictions representing valves, orifices, regulators and other pressurization system components. The fluid, thermal and mechanical equations describing the physical system are developed. The system equations are normalized and scaled for solution on the analog computer. The normalization method employed results in the system being completely determined by a set of dimensionless coefficients, thus, the analog computer model represents not a single physical system but the family of all geometrically similar physical systems. A particular solution generated by this analog model thus is applicable to all physically similar systems. It is notable that by this method, system variables such as absolute pressure levels, and thrust levels cease to be important parameters. Author

N71-12421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF A MODULAR TURBOJET COMBUSTOR BURNING NATURAL GAS FUEL
Nicholas R. Marchionna and Arthur M. Trout Washington Dec. 1970 25 p refs
(NASA-TN-D-7020; E-5740) Avail: NTIS CSCL 21E

A swirl-can modular combustor was tested with natural gas fuel. The rectangular combustor array simulated a 90 deg sector of a turbojet engine combustor. The combustor was tested at an inlet air pressure of 45 psia (31 N/sq cm), inlet air temperatures of 600 and 1200 F (589 and 922 K), and inlet Mach numbers of 0.24 and 0.31. Combustion efficiency was close to 100 percent at an average exit temperature of 2200 F (1480 K). Exit temperature distribution was excellent. At an inlet Mach number of 0.24, the pattern factor was 0.15 for a nominal inlet temperature 600 F (589 K) and 0.11 for a nominal inlet temperature of 1200 F (922 K). Total pressure loss was approximately 6.3 percent for an inlet Mach number of 0.30 and temperature ratio of 1.7. Author

N71-12422*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SHORTENING TRANSITION LINER TO DECREASE OVERALL LENGTH OF A RAM INDUCTION COMBUSTOR
Donald F. Schultz, Porter J. Perkins, and Jerrold D. Wear Washington Dec. 1970 20 p refs
(NASA-TN-D-7021; E-5691) Avail: NTIS CSCL 21E

The change in performance of a 40-inch (102-cm) diameter turbojet combustor, originally 30 inches (76 cm) long, was determined when it was shortened 5.0 inches (12.7 cm) at the discharge end. Design was for Mach 3.0 cruise inlet-air conditions of 90-psia (62-N/sq cm) total pressure and 1150 F (839 K) inlet-air temperature with an airflow rate of 108.6 lb/sec (49.3 kg/sec). The reduced length caused pattern factors to double (0.22 to 0.40), exit average circumferential temperature profiles to deteriorate, and efficiency to decrease slightly from 100 percent. Total pressure loss, exit average radial temperature profile, and smoke were not affected. Author

N71-12826*# Aerojet Liquid Rocket Co., Sacramento, Calif. Engine Components Dept.
IGNITION SYSTEM FOR SPACE SHUTTLE AUXILIARY PROPULSION SYSTEM Quarterly Technical Progress Narrative, 29 Jun. – 27 Sep. 1970
S. D. Rosenberg 17 Oct. 1970 80 p *Its* Quart. Tech. Progr. Narrative No. 1678-26-Q-1
(Contract NAS3-14348)
(NASA-CR-111515) Avail: NTIS CSCL 21C

A design review of the spark and plasma pulse igniters for the high and low chamber pressure design points and the injectors and chambers associated therewith and design changes which resulted from this review were completed. Fabrication of the high P sub c spark and plasma pulse igniters was completed. Fabrication of the companion igniters for the low P sub c design point was initiated and is nearing completion. Analytical work included heat transfer, stress and materials analysis in support of igniter design and the checkout and modification of the transient flow and turbulent mixing and combustion computer programs. Electrode durability tests with the spark igniter were completed satisfactorily. Nickel proved to be the best of the candidate materials. Author

N71-12939*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF NOISE SUPPRESSORS FOR A FULL-SCALE FAN FOR TURBOFAN ENGINES
Edward J. Rice [1970] 13 p refs Presented at the 9th Aerospace Sci. Meeting, New York, 25 – 27 Jan. 1971; Sponsored by AIAA
(NASA-TM-X-52941) Avail: NTIS CSCL 21E

Performance tests of inlet and exhaust noise suppressors for a six foot diameter fan for a high by-pass ratio turbofan engine are discussed. The perforated plate on honeycomb suppressors provided a much broader band noise attenuation than was predicted. The theory used for the design of the suppressors is discussed. The theory predicts the frequency for peak attenuation but underpredicts the peak attenuation amplitude. For frequencies above and below peak, the observed attenuations are more than predicted.

Degradations of the aerodynamic performance due to the noise suppressors were smaller than the experimental errors which were estimated to be two percent. Author

N71-12940*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF FACILITY BACKSPUTTERED MATERIAL ON PERFORMANCE OF GLASS-COATED ACCELERATOR GRIDS FOR KAUFMAN THRUSTERS
Robert T. Bechtel, Bruce A. Banks, and Thaine W. Reynolds [1970] 28 p refs Proposed for Presentation at Ninth Aerospace Sci. Meeting, New York, 25–27 Jan. 1971; sponsored by Am. Inst. of Aeron. and Astron.
(NASA-TM-X-52927) Avail: NTIS CSCL 21C

Testing of glass coated accelerator grids on mercury bombardment thrusters has revealed the presence of conductive coatings of facility backsputtered material on downstream glass surfaces. Tests in two vacuum tanks of different sizes indicated that these backsputtered coatings improve the beam current extraction capability of the grid. Results from these tests lead to several limitations on the type of facility which can be used for testing glass coated grids. Tests of several grids with different geometries have shown that grids which do not depend on backsputtered material for high beam current (1.5 amp) capability can be fabricated. Author

N71-12941*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY RESULTS OF THE OPERATION OF A SERT 2 THRUSTER ON ARGON
Ronald J. Schertler [1970] 28 p refs Proposed for presentation at Ninth Aerospace Sci. Meeting, New York, 25–27 Jan. 1971; sponsored by Am. Inst. of Aeron. and Astron.
(NASA-TM-X-52940) Avail: NTIS CSCL 21C

Preliminary results of the operation of a SERT II type, 15-cm electron bombardment thruster are reported. Results of incorporating an enclosed keeper into the thruster cathode design show that open and enclosed keeper cathodes yield comparable performance with mercury. Initial performance data with argon indicate that both low discharge chamber losses (240 electron volts per ion) and high propellant utilization efficiencies are obtainable. Discharge chamber performance with argon compares favorably with that of the SERT II mercury thruster. The discharge within the cathode-keeper region and the associated power level of keeper operation were found to influence the overall argon performance data. Author

N71-12962*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRESSURE MEASUREMENTS IN THE EXHAUST OF A PULSED MEGAWATT MPD ARC THRUSTER
Charles J. Michels and Thomas M. York (Pennsylvania State Univ.) [1970] 17 p refs To be presented at the 9th Aerospace Sci. Meeting, 25–27 Jan. 1971; Sponsored by AIAA
(NASA-TM-X-52939) Avail: NTIS CSCL 21C

Transient exhaust pressure history shows a large initial pressure pulse followed by lower order signals. The variation of this pulse with source parameters and duct position is discussed. The peak dynamic pressures are of order 10,000 N/sq m and static pressures are about 100 N/sq m. At a fixed position, the pulse increases with power, and/or magnetic field. Generally, the pulse occurs about 10 microseconds after plasma light arrives, and about 10 to 50 microseconds before plume current arrives and Faraday cup signals occur. This narrow neutral pulse dominates the time integrated pressure for approximately 100 microseconds. Author

N71-13024*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INVESTIGATION OF A MIXED-COMPRESSION AXISYMMETRIC INLET SYSTEM AT MACH NUMBERS 0.6 TO 3.5
Donald B. Smeltzer and Norman E. Sorenson Washington Nov. 1970 245 p refs
(NASA-TN-D-6078; A-3516) Avail: NTIS CSCL 21A

A 20-inch (50.8 cm) capture diameter model of a mixed-compression axisymmetric inlet system was tested. The design Mach number was 3.5 and off-design performance was obtained by translation of the cowl. The inlet system was 1.4 capture diameters long, measured from the cowlip to the engine face. Vortex generators were installed just downstream of the throat to reduce the total pressure distortion at the engine face. A boundary-layer removal system was provided on both the cowl and centerbody surfaces of the subsonic and supersonic diffuser. An engine airflow bypass system was located on the cowl surface just upstream of the engine face. The major performance parameters of bleed mass-flow ratio, total-pressure recovery, and total-pressure distortion were determined as a function of bypass mass-flow ratio. Other results obtained were transonic additive drag, inlet tolerance to change in angle of attack, boundary-layer profiles, and surface-pressure distributions. At Mach number 3.5 and zero bypass, total-pressure recovery ranged from 84.5 to 89.5 percent at the engine face with a bleed mass-flow ratio of 14 to 21 percent. The total-pressure distortion level was about 5 percent. Author

N71-13071*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF THE SERIES-HYBRID ROLLING-ELEMENT BEARING
Richard J. Parker, David P. Fleming, William J. Anderson, and Harold H. Coe Washington Dec. 1970 25 p refs
(NASA-TN-D-7011; E-5817) Avail: NTIS CSCL 13I

One approach to the high speed rolling-element bearing problem is the series-hybrid bearing. This concept couples a fluid-film bearing with a rolling-element bearing such that the rolling-element bearing inner race runs at a fraction of shaft speed. A series-hybrid bearing was run at thrust loads from 100 to 300 pounds (445 to 1340 N) and speeds from 4000 to 30,000 rpm. The lowest speed ratio (ratio of ball bearing inner-race speed to shaft speed) obtained was 0.67. Agreement between theoretical and experimental speed sharing was good; deviations were greatest at highest speeds. The series-hybrid bearing has the potential of substantially increasing high-speed bearing fatigue life. Author

N71-13072# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF ROCKET ENGINES
V. E. Alemasov et al 23 Jul. 1970 758 p refs Transl. into ENGLISH from Teoriya Raketnykh Dvigatelei (Moscow), 1969 p 1–547
(AD-713034; FTD-MT-24-116-70) Avail: NTIS CSCL 21/8

The book treats general questions of the theory and calculation of thermal rocket engines, describes processes of ZhRd and RDTT and considers their characteristics. The necessary information about liquid and solid fuels for RD is given. In the 2nd considerably reworked edition, contemporary methods of thermogas-dynamic design of processes in RD with high-temperature working media have been more fully explained. Results published in recent years of theoretical and experimental investigations to determine thermophysical features of combustion products and characteristics of chemically nonequilibrium processes combustion and expansion are reflected. Considerable attention is given to questions of the specific character of two-phase flows and to schemes of heat shielding. Author (TAB)

N71-13080*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COUPLED SUPERSONIC INLET-ENGINE CONTROL USING OVERBOARD BYPASS DOORS AND ENGINE SPEED TO CONTROL NORMAL SHOCK POSITION
Gary L. Cole, George H. Neiner, and Robert E. Wallhagen Washington Dec. 1970 38 p refs
(NASA-TN-D-6019; E-5499) Avail: NTIS CSCL 21A

An inlet normal shock control was investigated which used the inlet's high response bypass doors as the primary manipulated variable and engine speed as a slow-acting reset control. One advantage of this control concept over separate inlet and engine controls is that it allows the inlet's overboard bypass system to be operated at the most efficient position. Another advantage is that this control can correct for shock displacements in the aft direction when the bypass doors are initially closed, which is not accomplished by a separate inlet control. Experimental results show that the control operates satisfactorily, returning the inlet quickly to design conditions, when subjected to disturbances in diffuser exit corrected airflow. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N71-12641# Los Alamos Scientific Lab., N.Mex.
VELA 5 AND 6 SOLAR X-RAY ATLAS. 1: 27 MAY–1 SEPTEMBER 1969
N. K. Blocker, W. H. Chambers, P. E. Fehlau, J. C. Fuller, W. E. Kunz et al Jun. 1970 100 p refs Sponsored in part by ARPA
(Contract W-7405-eng-36)
(LA-4454) Avail: NTIS

Data obtained from the solar radiation monitors on the Vela 5 satellite are presented. Equivalent graybody flux in three bands (0.3 to 3, 1 to 8, and 1 to 16 A) is plotted as a function of universal time, one day per page. Data from May 27 to September 1, 1969 are presented. Author (NSA)

N71-12945# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Deep River Lab.
COSMIC RAY NEUTRON AND MUON MONITOR DIURNAL VECTORS. 4. FROM THE START OF SOLAR ROTATION NO. 1840 TO THE END OF SOLAR ROTATION NO. 1852, 19 JANUARY 1968–3 JANUARY 1969, AND VECTOR DIAGRAMS BY SOLAR ROTATION
John F. Steljes May 1970 117 p refs
(AECL-3651) Avail: AEC Depository Libraries

Daily diurnal and semi-diurnal variation vectors for both the muon and the neutron monitors at 4 cosmic ray stations in Canada are given in tabular form for the period from the start of solar rotation No. 1840 to the end of rotation No. 1852. The same vectors for the neutron and muon monitors at Kula, Hawaii and for the Bolivian neutron monitor at Chacaltaya are also given. The vectors were corrected for barometer and in the case of the muons, except at Kula, for the atmospheric temperature wave using hourly values of the temperature and barometric pressure measured near the ground. Graphs of the vectors at each station for successive solar rotations are also given. Author

N71-12946# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Deep River Lab.
COSMIC RAY NEUTRON AND MUON MONITOR DIURNAL VECTORS. 3. FROM THE START OF SOLAR ROTATION NO. 1826 TO THE END OF SOLAR ROTATION NO. 1839, 6 JANUARY 1967–18 JANUARY 1968, AND VECTOR DIAGRAMS BY SOLAR ROTATION
John F. Steljes Apr. 1970 123 p refs
(AECL-3608) Avail: AEC Depository Libraries

Daily diurnal and semi-diurnal variation vectors for both the muon and the neutron monitors at four cosmic-ray stations in Canada are given in tabular form for the period from the start of solar rotation No. 1826 to the end of rotation No. 1839. The same vectors for the neutron and muon monitors at Kula, Hawaii, and for the Bolivian neutron monitor at Chacaltaya, are also given. The vectors were corrected for barometer and in the case of the muons, except at Kula, for the amospheric temperature wave using hourly values of the temperature and barometric pressure measured near the ground. Graphs of the vectors at each station for successive solar rotations are also given. Author (NSA)

N71-13025*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATION OF THE PLASMAPAUSE POSITION TO THE REGION OF ENHANCED FLUXES OF TRAPPED ENERGETIC (E>280 keV) ELECTRONS DURING THE 15 JUNE 1965 MAGNETIC STORM
D. L. Carpenter (Stanford Univ.), C. G. Park (Stanford Univ.), J. F. Arens, and D. J. Williams (ESSA, Boulder, Colo.) Nov. 1970 15 p refs Submitted for publication
(Grants NGL-020-008; NSF GA-1151; NSF GA-1485; NSF GA-775; NSF GA-1445 et al)
(NASA-TM-X-65390; X-646-70-427) Avail: NTIS CSCL 03B

The position of the plasmapause relative to the region of appearance of enhanced fluxes of energetic (E > 280 keV) electrons during the magnetic storm of June 15, 1965 is reported. The plasmapause was measured near the prime geomagnetic meridian by whistler techniques; the trapped energetic electrons were detected by the satellite 1963-38C in polar orbit at 1100 km altitude. As the storm-time reduction in plasmasphere radius occurred, the electron fluxes increased in a region that was apparently exterior to the diminishing plasmasphere. The plasmapause position appears to have been adjacent to the region of inflation of the magnetosphere reported by Cahill from Explorer 26 magnetometer data. This relationship is similar to that deduced from the OGO-3 measurements of ring current particles and thermal ion density. Author

N71-13033*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SILICON BURNING AND THE SYNTHESIS OF COSMIC-RAY NUCLEI
Donald V. Reames Dec. 1970 10 p refs Submitted for publication
(NASA-TM-X-65389; X-662-70-423) Avail: NTIS CSCL 03B

The source abundances of the cosmic ray nuclei of atomic number 14 < or = to Z < or = to 28 are found to be in good agreement with calculations based on the quasi-equilibrium silicon burning process. The low-density environment appropriate for cosmic-ray nucleosynthesis differs from that required for synthesis of the observed solar-system (universal) abundances in a way which is consistent with the shock acceleration model for the supernova origin of the nuclei observed in both abundance measurements. Author

N71-13034*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVED GALACTIC HARD X-RAY EMISSION AS AN INDICATION FOR COSMIC RAY HEATING OF INSTELLAR HI
Elihu Boldt Nov. 1970 15 p refs Submitted for publication
(NASA-TM-X-65388; X-661-70-422) Avail: NTIS CSCL 03B

The intensity and spectral shape of the diffuse X-ray emission by the galactic disk are found to be consistent with bremsstrahlung radiation arising from knock-on collisions of subrelativistic cosmic ray protons with atomic electrons of interstellar HI. This association is based on relating the observed X-ray emission with (1) recent estimates of the ionization rate for heating the interstellar gas in HI regions, and (2) the lifetime of cosmic rays confined to the galactic disk. The possible role of cosmic ray electrons in the production of this diffuse galactic X-ray emission is examined, and several arguments lead to the conclusion that it is probably unimportant. Author

N71-13079 Kodaikinal Observatory (India).
NARROW BAND PHOTOMETRY OF RHO PUPPIS
A. Thulosi Doss 1969 12 p refs *Its* Ser. A, No. 191
Copyright. Avail: Issuing Activity

Monochromatic flux values of the dwarf Cepheid Rho Puppis have been evaluated over the cycle from observations made in the 1967 season through four narrow band filters centered at 3858 A 4310 A, 4720 A and 5875 A. The amplitudes at the above wavelengths are 0.17, 0.14, 0.12 and 0.09 magnitudes respectively. The effective temperature variation over a cycle is 320 K. Photoelectric light curves have also been obtained in Blue and Yellow colors and amplitude of light variations are 0.15 and 0.09 respectively. The period is further improved as 0.14088067 day.
Author

N71-13086 Kodaikanal Observatory (India).
COMET IKEYA-SEKI (1965) AND THE NATURE OF THE INTERPLANETARY MEDIUM DURING ITS APPARITION
M. K. V. Bappu and K. R. Sivaraman 1969 7 p refs *Its* Ser. A, No. 187
Copyright. Avail: Issuing Activity

The effects of a solar wind on the different parts a comet are discussed in terms of the observations obtained of Comet Ikeya-Seki (1965f). The solar wind contribution to the formation of the scattering agencies in the comet nucleus is shown to be negligible. Isophotes of the coma in the light of the CN(0,0) emission band and Na 5893 A derived from slitless spectra are presented. Te heliocentric distance of the termination point of Na emission is shown to be dependent on the varying nature of the interplanetary medium properties at different phases of the solar cycle.
Author

N71-13172 Kodaikanal Observatory (India).
A DOPPLER COMPARATOR FOR SOLAR SPECTRA
Aleksandar Kubicela and K. R. Sivaraman 1969 6 p ref *Its* Ser. A, No. 189
Copyright. Avail: Issuing Activity

The determination of the local Doppler displacements using lines of different mean depths of formation, and observations of velocity fields associated with super-granular cells as well as those of the quasi-periodic vertical oscillations in the photosphere are studied with a Doppler comparator. In this device the light flux from the wings of a spectral line are directed to two light-dependent resistances (LDR) through a system of two slits with their centers located at plus or minus delta on the line profile. Determination of Doppler displacement at any location on the line is accomplished by equalizing the dc output signals of the two LDR; setting the two slits with a micrometer screw so that the line is centered on them and reading this displacement on the micrometer scale. The spectral line is scanned manually along its length and Doppler displacements are obtained at discrete points.
Author

N71-13173 Kodaikanal Observatory (India).
THE SOLAR CORONA OF 20 JULY 1963
M. K. V. Bappu and A. Bhatnagar 1969 12 p refs *Its* Ser. A, No. 190
Copyright. Avail: Issuing Activity

The total solar eclipse of July 20, 1963 was observed at the AAVSO site near Wilton, Maine, USA where totality lasted for 58 seconds. Pictures of the corona were obtained with a camera of focal length 57 cm. on Kodak Plus X emulsion through a Wratten 15G filter. Photometric calibrations were impressed with a Hilger step wedge. Coronal isophotes have been derived by the Sabattier procedure and intensities assigned to the equidensity contours by conventional microphotometry. Tables given contain the brightness distribution for different position angles to $r = 4.2$ solar radii. The coronal intensity gradients are presented over the range $r = 1.4$ to 2.8. The Ludendorff index of the corona's photometric form is 0.24.
Author

N71-13283# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
THE SOLAR WIND
Carl-Gunne Faelthammar Aug. 1970 29 p refs
(Rept-70-22) Avail: NTIS

The general properties, composition and recurrent streams in the interplanetary plasma are described. The origin and structure of the interplanetary magnetic field and the magnetic guiding of energetic particles as well as solar wind properties and geomagnetic activity are discussed.
ESRO

N71-13287 Kodaikanal Observatory (India).
KODAIKANAL OBSERVATORY BULLETIN NO. 174
3 Apr. 1970 342 p refs
(Bull-174) Copyright. Avail: Issuing Activity

Graphs are plotted and tables formulated of the observations of prominences and calcium flocculi made at Kodaikanal Observatory during the first half of 1964. These data are supplemented by photographs supplied by Meudon Observatory for those days on which Kodaikanal had imperfect or no observations.
E.M.C.

N71-13332# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ON SPACE CHARGE REGIONS ABOVE THE AURORA
Per Carlqvist and Rolf Bostroem Jun. 1970 20 p refs
(Rept-70-18) Avail: NTIS

Observations have shown that field-aligned currents above auroras reach such magnitudes that space charge regions of high potential drops can be expected. Some effects of the electric fields associated with such a space charge region e.g. acceleration of auroral electrons and horizontal motions in the visual aurora are discussed.
Author (ESRO)

N71-13333# Groupe de Recherches Ionospheriques, Paris (France).
BIBLIOGRAPHIC SURVEY ON THE RELATIONS BETWEEN DIFFERENT SOLAR WIND PARAMETERS AND GEOMAGNETIC ACTIVITY [MISE AU POINT BIBLIOGRAPHIQUE SUR LES RELATIONS ENTRE DIVERS PARAMETRES DU VENT SOLAIRE ET L'ACTIVITE GEOMAGNETIQUE]
Annick Berthelier 15 Sep. 1970 48 p refs In FRENCH
(GRI/NT/79) Avail: NTIS

A bibliographic survey is presented on the correlation between geomagnetic activity and the velocity of the solar wind, the intensity of the interplanetary magnetic field, its fluctuations and direction. Data obtained with the Pioneer 5, Explorer 12 and IMP satellites, and the Mariner spacecraft are discussed.
ESRO

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N71-12228*# Translation Consultants, Ltd., Arlington, Va.
SOME RESULTS OF THE FLIGHT OF THE SOYUZ 9 SPACECRAFT [NEKOTORYYE ITOGI POLETA KOMICHESKOGO KORABLYA 'SOYUZ-9']
A. G. Nikolayev Washington NASA Dec. 1970 11 p Transl. into ENGLISH of Russian report Presented at a meeting of the AIAA, Houston, Tex., Oct. 1970
(Contract NASw-2039)
(NASA-TT-F-13414) Avail: NTIS CSCL 22A

The long-term effects on the human body of factors involved in space flight were studied on the Soyuz 9 flight. In the personal

opinion of the spacecraft commander the following effects were reported: (1) Muscular coordination breaks down in the first hours of weightlessness. Gradually it is restored. (2) There was a reduction of mineral content of the bones, and no sensation of thirst was experienced during the flight, although there was an increase in the fluid eliminated during the first hours of weightlessness. (3) Sleep was normal during the flight. (4) After landing, the head and extremities seemed heavy, and difficulty was experienced in rising. This sensation gradually disappeared, and was completely gone in five or six days. Also standing and walking was difficult. The walk was characterized as a stamping gait which returned to normal after ten days. F.O.S.

N71-12229*# Scripta Technica, Inc., Washington, D.C.
DISPERSION OF FAST FLUCTUATIONS IN THE DECELERATION OF SATELLITES AT DIFFERENT ALTITUDES [DISPERSIYA BYSTRYX FLUKTUATSIY V TORMOZHENII SPYTNIKOV NA RAZLITSNYX VYSOTAKH]
N. P. Slovokhotova et al NASA Dec. 1970 3 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 53, issue 1, 1969 p 4–6
(Contract NASw-2036)
(NASA-TT-F-13286) Avail: NTIS CSCL 22A

Dispersions of relative fluctuations in the deceleration of satellites orbiting nearly at the same time on different heights were computed. It is shown that the change of dispersion with height agrees with the idea that the source of weekly thermal fluctuations is concentrated on an effective height Z sub O = (112 to 117) km. Author

N71-12282# Battelle-Northwest, Richland, Wash. Applied Mathematics Dept.
PHOTOMETRIC MAP OF THE MILKY WAY
L. L. Smith, F. E. Roach, and R. W. Owen Jun. 1970 32 p refs
(Contract AT(45-1)-1830)
(BNWL-1419) Avail: NTIS

Tables of digitized absolute values of brightness of the Milky Way in one-degree intervals are given. The tables are useful in studies of the zodiacal light, the night airglow, the diffuse galactic light, and the cosmic light. NSA

N71-12283*# Scripta Technica, Inc., Washington, D.C.
DETERMINATION OF THE COMPOSITE ERRORS IN THE VISUAL TRACKING OF SATELLITES [OPREDELENIYE SUMMARNYKH POGRESHNOSTEY PRI VIZUAL NYKH NABLYUDENIYAKH ISZ]
V. I. Kuryshev NASA Dec. 1970 10 p Transl. into ENGLISH from Byull. Sta. Opt. Nablyudeniya Iskusstvennykh Sputnikov Zemli (Moscow), no. 53, Issue 1, 1969 p 46–52
(Contract NASw-2036)
(NASA-TT-F-13355) Avail: NTIS CSCL 22C

A method is presented for establishing and accounting for the composite errors of goniometer instruments used for visual observation of satellites in the horizontal system of coordinates. The composite instrumental corrections are computed from observations made on comparison stars on selected almucantars. Corrections for the composite errors (instrumental and others) are simply and expeditiously inserted into the measured coordinates from the appropriate curves, thereby significantly improving the accuracy of the satellite observations. Author

N71-12284*# Scripta Technica, Inc., Washington, D.C.
PRELIMINARY RESULTS OF DETERMINATION OF THE NIKOLAJEV-HELWAN SPACE DIRECTION [PREDVARITELNYYE REZULTATY OPREDELENIYA PROSTRANSTVENNOGO NAPRAVLENIYA NIKOLAYEV-KHELUAN]
A. Dinescu NASA Dec. 1970 4 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 53, issue 1, 1969 p 27–28
(Contract NASw-2036)
(NASA-TT-F-13348) Avail: NTIS CSCL 17H

The simultaneous circle method for determination of space directions between tracking stations situated at long distances is verified. The direction Nikolajev-Halvan was determined by using five pairs of simultaneous photographic observations of the satellite Echo-2 during spring 1966. Several considerations concerning favorable conditions are presented. Author

N71-12416*# Translation Consultants, Ltd., Arlington, Va.
THE HISTORICAL DEVELOPMENT OF ROCKETS AND THE PURPOSE AND LIMITS OF TECHNOLOGY [DIE GESCHICHTE DER RAKETENENTWICKLUNG UND UEBER SINN UND GRENZEN ALLERTECHNIK]
Fritz von Opel Washington NASA Dec. 1970 34 p Transl. into ENGLISH from German Rept. Presented at the German Museum, Munich, 3 Apr. 1968
(Contract NASw-2038)
(NASA-TT-F-13436) Avail: NTIS CSCL 19G

The earliest development of rockets and their use in both the ancient East and West are discussed. The decline and subsequent revival of rocket research is considered, with emphasis given to the work of the author. The limits of all technology are examined and future trends in its future development are given. R.B.

N71-12420# National Aeronautics and Space Administration, Washington, D.C.
AMERICA'S NEXT DECADES IN SPACE A Report for the Space Task Group
Sep. 1969 88 p
(NASA-TM-X-66499) Avail: NTIS CSCL 22A

A space program is outlined which was designed to provide a continuing output of benefits in practical applications, science, and technology and simultaneously the development of new and improved capabilities required for the exploration of the solar system. The major elements of the proposed civilian space program include the early development and operation of a permanent manned station in near-earth orbit to provide experience on long-duration manned flight, practical benefits through observation of the earth and its environment, and scientific research. Further recommendations include: (1) the design of a new and truly low-cost space transportation system as an integral part of the space station concept; (2) planetary exploration with continuing missions to the near planets followed by missions to Jupiter and outer planets; and (3) sustained efforts to develop means for more effective control of our environment and management of our resources, as well as new services in communications, navigation, and air traffic control. D.L.G.

N71-12423*# Scripta Technica, Inc., Washington, D.C.
CALCULATION OF THE INSTANTS WHEN AN ARTIFICIAL SATELLITE CROSSES A CERTAIN CÉLESTIAL CIRCLE [O VYCHISLENII MOMENTOV PROKHOZHDENIYA ICKUSSTVENNOGO SPUTNIKA ZEMLI CHEREZ OPREDELENNYY NEBESNYY KRUG]
M. Ill NASA Dec. 1970 6 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 53, Issue 1, 1969 p 23–26
(Contract NASw-2036)
(NASA-TT-F-13347) Avail: NTIS CSCL 22A

A method for the evaluation of the time of a satellite's crossing a certain celestial circle is described based on the utilization of the velocity of the subsatellite point. The latter is determined as the difference of the latitudes of two subsatellite points for a given interval of time. Author

N71-12556*# Library of Congress, Washington, D.C. Federal Research Div.
LUNA-16 SOIL SAMPLES

A. P. Vinogradov NASA Dec. 1970 5 p Transl. into ENGLISH from Pravda (USSR), 29 Oct. 1970 3 p Sponsored by NASA (NASA-TT-F-13432) Avail: NTIS CSCL 03B

The analysis results of the lunar soil samples returned by the Soviet probe are discussed. The Luna-16 drill had penetrated into the moon's loose soil cover, meeting resistance only at a depth of about 345 mm, when it came up against either bedrock or a large rock fragment. The drill was able to penetrate only 5mm further (to a total depth of 350 mm) as was later confirmed by an examination of the core-sample. The drill was completely filled by the sample of loose lunar regolith. When it was removed to an examination tray it did not have a layered appearance and appeared uniform through its length. Only a small part of the soil at the drillface, at a depth of approximately 35 cm., consisted of more coarsely-grained material. Author

N71-12702# Bochum Univ. (West Germany). Fachbereich Extraterrestrische Physik.

INTRODUCTION TO THE PHYSICAL PROPERTIES OF SPACE [EINFUEHRUNG IN DIE PHYSIKALISCHEN EIGENSCHAFTEN DES WELTRAUMES]

R. H. Giese *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 1 1970 34 p refs In GERMAN (See N71-12701 03-11)
Avail: NTIS

A survey is given of physical processes in the upper atmosphere, the solar wind, the magnetosphere, including radiation belts, as well as interplanetary dust. ESRO

N71-12944# Royal Aircraft Establishment, Farnborough (England).

ORBITAL ELEMENTS FOR TRANSIT 1 B

H. Hiller Aug. 1969 30 p refs
(RAE-TR-69186) Copyright. Avail: NTIS

A computer program for the refinement of the orbital parameters of a satellite, PROP, was used to determine the orbit of Transit 1B (1960 gamma 2) for epochs spread throughout the life of the satellite. About 200 observations were used from 45 different stations to obtain orbital parameters at each epoch. Most of the observations were visual, but some photographic and radar observations were also used. The orbital parameter of chief interest for geophysical studies is the inclination, and accurate values of this parameter were obtained, the s.d. varying between 0.0004 deg for the best orbits and 0.07 deg for the worst. Author

N71-12982# Arizona Univ., Tucson. Steward Observatory.

SYMPOSIUM ON DARK NEBULAE, GLOBULES AND PROTOSTARS: GLOBULES

Bart J. Bok, Carolyn S. Cordwell, and Richard H. Cromwell [1970] 28 p refs *Its* Preprints of the Steward Obs. No. 26
Avail: NTIS

A list of representative globules and dark nebulae is provided for use by both optical and radio astronomers. A table containing a check list of 16 centers near which one or more good sample globules or dark nebulae are located is given. R.B.

N71-12957*# National Aeronautics and Space Administration, Washington, D.C.

SAS-A (TO BE LAUNCHED NO EARLIER THAN 12 DECEMBER): PRESS KIT

2 Dec. 1970 28 p
(NASA-News-Release-70-203) Avail: NASA Scientific and Technical Information Division

The December launching of the United States Small Astronomy Satellite-A by an Italian team of space engineers is reported. The satellite is equipped with sensitive experiments to detect high-energy X-ray sources in space. R.B.

N71-12964# Arizona Univ., Tucson. Steward Observatory.

OBSERVATIONAL EVIDENCE FOR GALACTIC SPIRAL STRUCTURE

Bart J. Bok [1970] 50 p refs Presented at the Gen. Assembly of the Intern. Astron. Union, Brighton, England, 24 Aug. 1970 *Its* Preprints of the Steward Obs. No. 33
Avail: NTIS

An overview is presented of evidence that suggests the presence of an underlying structure of spiral features for our galaxy. Topics covered in the discussion include: (1) spiral structure of Messier 31; (2) basic problems of our galaxy; (3) spiral tracers; (4) optical spiral structure; (5) kinematics of gas and stars; and (6) radio evidence from continuum studies and recombination lines. D.L.G.

N71-13009# Academy of Sciences (USSR), Moscow. Astronomical Council.

TRACKING DATA ON SOVIET ARTIFICIAL EARTH SATELLITES, NO. 120. COSMOS 54: 1965 11D (ROCKET). HORIZONTAL COORDINATES, JANUARY–DECEMBER 1967

1969 83 p In RUSSIAN
Avail: NTIS

Tabulated observations on Cosmos 54 include data on the tracking station number, universal time of observation, and horizontal coordinates. Transl. by E.C.

N71-13010# Academy of Sciences (USSR), Moscow. Astronomical Council.

TRACKING DATA ON SOVIET ARTIFICIAL EARTH SATELLITES, NO. 122. COSMOS 71: 1965 53F (ROCKET). HORIZONTAL COORDINATES, JANUARY–DECEMBER 1967

1969 102 p In RUSSIAN
Avail: NTIS

Tabulated observations on Cosmos 71 include data on the tracking station number, universal time of observation, and horizontal coordinates. Transl. by E.C.

N71-13011# Academy of Sciences (USSR), Moscow. Astronomical Council.

TRACKING DATA ON SOVIET ARTIFICIAL EARTH SATELLITES, NO. 119. COSMOS 54: 1965 11D (ROCKET). EQUATORIAL COORDINATES, JUNE–DECEMBER 1967

1969 57 p In RUSSIAN
Avail: NTIS

Tabulated observations on Cosmos 54 include data on the tracking station number, universal time of observation, and equatorial cordinates. Transl. by E.C.

N71-13012# Academy of Sciences (USSR), Moscow. Astronomical Council.

TRACKING DATA ON SOVIET ARTIFICIAL EARTH SATELLITES, NO. 118. COSMOS 55: 1965 11D (ROCKET). EQUATORIAL COORDINATES, JANUARY–MAY 1967

1969 72 p In RUSSIAN
Avail: NTIS

Tabulated data on the rocket section of Cosmos 55 include the tracking station number, times of observations, and equatorial coordinates for the period Jaunary to May 1967. Transl. by R.B.

N71-13015# Academy of Sciences (USSR), Moscow. Astronomical Council.

TRACKING DATA ON SOVIET ARTIFICIAL EARTH SATELLITES, NO. 116. POLYOT 1: 1963 43A (SATELLITE). EQUATORIAL COORDINATES, JANUARY–DECEMBER 1967

1969 88 p In RUSSIAN
Avail: NTIS

Tabulated data on the Polyot 1 satellite include the number of the tracking statins, the times of observations, and equatorial coordinates for the period January to December 1967. Transl. by R.B.

N71-13016# Academy of Sciences (USSR), Moscow. Astronomical Council.

TRACKING DATA ON SOVIET ARTIFICIAL EARTH

SATELLITES, NO. 121. COSMOS 71: 1965 53F (ROCKET). EQUATORIAL COORDINATES, JANUARY–DECEMBER 1967
1969 95 p In RUSSIAN
Avail: NTIS

Tabulated observations on Cosm's 71 include data on the tracking station number, universal time of observation, and equatorial coordinates. Transl. by E.C.

N71-13039# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 239 28 Oct. 1970 p 1–7 (See N71-13038 03-34)
Avail: NTIS

News briefs and abstracts are presented on radio telescopes, perturbation of Juno by large planets, theory of planetary satellite motion, and westward drift of continents. F.O.S.

N71-13043# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 239 28 Oct. 1970 p 57–76 (See N71-13038 03-34)
Avail: NTIS

News briefs and abstracts of articles are presented on the operation of a drill rig on the moon, receiving coherent waves from satellites, genetic research in space, the return flight of Luna-16, cosmic ray studies and ion formation rates in the atmosphere. The launchings of Cosmos 365, 366, 367, 368, and 370 satellites are announced with their orbit parameters. F.O.S.

N71-13058*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SECOND-ORDER ARTIFICIAL SATELLITE THEORY BASED ON AN INTERMEDIATE ORBIT
Kaare Aksnes 1 Nov. 1970 41 p refs
(Contract NAS7-100)
(NASA-CR-111557; JPL-TR-32-1507) Avail: NTIS CSCL 22C

An analytical second-order theory is developed for the motion of a satellite of an oblate planet whose gravitational potential includes the second, third, and fourth zonal harmonics. It is assumed that J sub 2 is a small quantity of the first order and that J sub 3 and J sub 4 are of the second order. The secular and the periodic perturbations are obtained to the third and to the second order, respectively. The former are contained in the Delaunay variables which are linear functions of the time, while the latter are given as additions to the Hill variables in the form of trigonometric series with constant coefficients. The theory is distinguished by a relative simplicity and compactness of the final algorithm achieved by the use of the following special devices and techniques: (1) an intermediate orbit, (2) Hori's perturbation method, and (3) the Hill variables. A comparison with the results of numerical integration of the equations of motion indicates that the theory is capable of predicting the position of a near-earth satellite to better than one meter over one hundred revolutions. Author

N71-13180# Thessaloniki Univ. (Greece). Dept. of Astronomy.
RESEARCH IN THE RESTRICTED THREE-BODY PROBLEM
Final Scientific Report, 1 May 1966–30 Apr. 1969
G. Contopoulos, G. Bozis, and J. Hadjidemetriou Sep. 1970 8 p refs
(Contract AF 61(052)-952)
(AD-712725; AFOSR-70-2474TR) Avail: NTIS CSCL 3/3

Numerical evidence has been given of the existence of a new integral in the Restricted Problem. This integral was expressed in terms of the Delaunay variables in a series form in powers of the mass ratio mu, the eccentricity e and the semi-major axis a. It was shown that Stromgrens family and Henons family of periodic orbits known are linked through the mass ratio mu. Families of figure eight orbits were studied. The same approach was used for other families of periodic orbits. It was again found that certain families are connected. The report has classified the orbits in the restricted 3-body problem which pass through the ineer Lagrangian point L1, according to their first minimum distance from either primary, both for planar and three dimensional orbits. The report has studied the stability of periodic orbits in the restricted three-body problem and similar problems, by studying the variational equations. The report has found several properties of the solutions of the variational equations, and using these properties it has proved that orbits which are linearly stable are also stable to second order terms in the initial displacements. The report has also found the characteristic curves of stable periodic orbits by using the results mentioned above, and also using the third integral. Author (TAB)

N71-13195# California Univ., Los Angeles.
RICH CLUSTERS OF GALAXIES Final Technical Report
George O. Abell 30 Sep. 1970 6 p
(Contract N00014-67-C-0197)
(AD-712807; TR-10) Avail: NTIS CSCL 3/2

The report reviews rich clusters of galaxies. Progress has been made in the study of distributions of clusters in groups of various richness. Photometry studies were completed on the elliptical galaxies in the Virgo Cluster. Author (TAB)

N71-13199*# Oregon State Univ., Corvallis. Dept. of Chemistry.
ACTIVATION ANALYSIS FOR SELECTED ELEMENTS IN MICROMETEORIES AND HYPERVELOCITY PROJECTILES
Annual Progress Report, 1 Jul. 1969–1 Jul. 1970
Romin A. Schmitt and Thurman Cooper 1 Jul. 1970 10 p
(Grant NGL-38-002-032)
(NASA-CR-108707) Avail: NTIS CSCL 03B

Activation analysis to determine suitable materials to be used as a catcher for micrometeoroids is discussed. Two requirements are involved: (1) a sufficient analytical tool to detect elements at the nanogram level and (2) a material to serve as a catcher free of the elements sought after. Materials considered are: (1) aluminum, (2) polyethelene, (3) beryllium, (4) carbon, (5) potassium chloride crystals, and (6) silicon. Potassium chloride crystals and high purity silicon appear to be the most advantageous materials for the purpose. Author

N71-13256# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
PROCEEDINGS OF THE SEVENTH ESRO SUMMER SCHOOL. PLANETARY SPACE MISSIONS. VOLUME 3: ELECTRIC AND MAGNETIC FIELDS IN THE SOLAR WIND
Paul J. Coleman, Jr. Paris ESRO Sep. 1970 80 p refs Conf. held at Interlaken, Switz., 1969
(ESRO-SP-55) Avail: NTIS

A comprehensive account of theoretical and experimental work on the solar wind is given. Theories for auroral and geomagnetic activity are reviewed and Parker's solar wind and interplanetary magnetic field models are described as well as instruments for measuring interplanetary electric and magnetic fields. Plasma wave studies are reviewed and solar wind observations obtained with various space probes are discussed. Author (ESRO)

N71-13257# Kiel Univ. (West Germany). Mathematisch-Naturwissenschaftliche Fakultaet.
PROPAGATION AND STORAGE OF COSMIC-RAY RADIATION IN GALACTIC MAGNETIC FIELDS WITH ADDITIONAL TURBULENT FIELD [AUSBREITUNG UND SPEICHERUNG DER HOEHENSTRAHLUNG IN GALAKTISCHEN MAGNETFELDERN MIT TURBULENTEM ZUSATZFELD]
Heinz Dieter Middendorf (Ph.D. Thesis) Jan. 1970 70 p refs In GERMAN Sponsored by Deut. Forsch. Gemeinschaft
Avail: NTIS

The propagation of energetic particles under realistic astrophysical conditions is determined by the turbulent motion of

background plasma and connected electromagnetic microstructure. Based on these conditions, the theory of single particle motion in fields with statistically distributed irregularities is applied to a large structurized galactic model field, in order to obtain quantitative results for collective interactions in the cosmic radiation for a turbulent mechanism. ESRO

N71-13258# Royal Greenwich Observatory, Herstmonceux (England).
PROPER MOTIONS IN THE FIELD OF THE OPEN CLUSTER NGC 6939
R. D. Cannon and A. G. Purcell 1970 16 p refs *Its* Bull. No. 158
Avail: NTIS

A color-magnitude diagram for the NGC 6939 cluster, free from the influence of field stars, was required so the investigation was limited to the central region. Using plates taken on the 60-inch reflector on Mount Wilson, relative proper motions were determined for 232 stars, of which 173 were classed as possible cluster members. It was found that several stars lying near the main sequence well above the evolutionary turn-off point are probable members of the cluster, that the red giant branch extends beyond the concentration of stars to include a few much redder stars, and that probably a gap occurs in the evolved main sequence at its upper end. Author (ESRO)

N71-13275# Mount Wilson Observatory, Pasadena, Calif.
[FAINT STAR AND GALAXY RESEARCH AND INSTRUMENTATION IMPROVEMENT] Final Report
Jesse L. Greenstein 10 Sep. 1969 4 p Prepared in cooperation with Palomar Obs.
(Grant Nonr(G)-00060-65)
(AD-712826) Avail: NTIS CSCL 3/2

The report describes research on fainter stars and galaxies, using the prime-focus spectrograph of the 200-inch Palomar. It describes instrumental improvements, Scientific results, and technical details of instrumentation. TAB

N71-13371# Lowell Observatory, Flagstaff, Ariz.
PHOTOMETRIC OBSERVATIONS OF THE OCCULTATIONS OF STARS BY THE MOON Final Report
John S. Hall 9 Oct. 1970 12 p refs
(Contract N00014-68-C-0153)
(AD-712544) Avail: NTIS CSCL 3/2

Timings of occultations ranging in accuracy from 0.2 m/sec to 20 m/sec have been measured and forwarded to the U.S. Naval Observatory, Nautical Almanac Office. Diffraction patterns which indicate the possibility of diameter measures have been observed for 8 stars. At least one pattern indicating duplicity of an apparent single star has been observed. A theoretical curve was produced by summing the individual patterns of the two stars separated by 0.010 arc/sec and of relative intensities of 3.4 and 1.0. Their diameters were 0.000 and 0.001 arc/sec. Author (TAB)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N71-12618*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE STAR COMPUTER: A SELF-TESTING-AND-REPAIRING COMPUTER FOR SPACECRAFT GUIDANCE, CONTROL, AND AUTOMATIC MAINTENANCE
Algirdas Avizienis *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 13 p refs (See N71-12601 03-21)
(Contract NAS7-100)
(NASA-CR-111577) Avail: NTIS CSCL 22A

The success of long-term missions of unmanned spacecraft in the exploration of the solar system depends on the survival of the spacecraft during long intervals of interplanetary flight. Missions of up to 12 years duration are being considered for the Grand Tour multiple-planet flyby in the 1970's. The long unattended life requirement and the extreme communication distances impose immense reliability requirements on the onboard digital computer which performs the guidance and control computations. An experimental aerospace computer with built-in automatic maintenance features is described. The hardware, the software, and the estimation of reliability of the STAR computer are discussed. Extension of the STAR concepts to automatic maintenance of other systems of an unmanned interplanetary spacecraft is also considered. Author

N71-12620*# DBA Systems, Inc., Lanham, Md.
REAL-TIME DATA PROCESSING AND ORBIT DETERMINATION ON THE APOLLO TRACKING SHIPS
Frederick C. Johnson (Boeing Sci. Res. Labs.) *In* AGARD The Appl. of Digital Computers to Guidance and Control Nov. 1970 10 p (See N71-12601 03-21)
(Contract NAS5-9922)
(NASA-CR-111576) Avail: NTIS CSCL 22A

The Apollo instrumentation ships (AIS) are used during an Apollo lunar mission to provide radar and telemetry coverage during critical mission events that generally cannot be seen by the land-based portion of the Apollo tracking network. The tracking and orbit determination functions of these ships and the instrumentation hardware and real-time software that support these functions are considered. The general philosophy and design concepts of the real-time acquisition and tracking program in use on the AIS is discussed as well as the procedures that were used to minimize the problems associated with the development and test phases of the program. Author

N71-12984# Technische Hochschule Munchen (West Germany). Fakultaet fuer Maschinenwesen.
THE RELATIVE INFORMATION GAIN AS CRITERION FOR THE CONSTRUCTION OF RESEARCH SATELLITES [DER RELATIVE INFORMATIONSGEWINN ALS KRITERIUM FUER DIE AUSLEGUNG VON FORSCHUNGSSATELLITEN]
Reiner Konrad Huber (Ph.D. Thesis) 1970 190 p refs In GERMAN
Avail: NTIS

A yield function for scientific satellite experiments is formulated that evaluates the completeness degree of the relative information gain in relation to data rate, data storage, and data transfer for: (1) accuracy in coding measured values and reconstruction after data transfer; and (2) chronological classification of events flow. These yield functions are optimized by Lagrange multipliers through analysis of the overall available data rate for distribution to single experimental measurement channels so that the sum of satellite experiment results is maximal. Example calculations for 22 measurement channels of the proton experiment on the German Azur satellite are included. Transl. by G.G.

N71-13001# Joint Publications Research Service, Washington, D.C.
DESIGN AND TESTING OF BALLISTIC MISSILES
V. I. Verlokamayev, ed. et al 19 Nov. 1970 415 p refs Transl. into ENGLISH of the book 'Proyektirovaniye i Ispytaniye Ballisticheskikh Raket' Moscow, Mil. Publishing House of Min. of Defense USSR, 1969 p 1-392
(JPRS-51810) Avail: NTIS

CONTENTS:

1. BALLISTIC MISSILE DESIGN, PART 1 p 6-241 (See N71-13002 03-31)

2. TECHNICAL-MILITARY DESIGN OF ELEMENTS OF MISSILE COMPLEXES, PART 2 p 240-322 (See N71-13003 03-31)

3. EXPERIMENTAL DEVELOPMENT AND TESTING OF MISSILES, PART 3 p 323-395 (See N71-13004 03-31)

N71-13002# Joint Publications Research Service, Washington, D.C.

BALLISTIC MISSILE DESIGN, PART 1

In its Design and Testing of Ballistic Missiles 19 Nov. 1970 p 6-241 (See N71-13001 03-31)

Avail: NTIS

The methods of approximate missile design are discussed, including design problems, trajectory calculations, and weight analysis. The selection of missiledesign parameters, such as number of stages, mass distribution, and combustion chamber and nozzle exit pressures is described for liquid and solid propellant missiles. Design features of liquid and solid missiles and boosters are summarized, and the use of computerized calculations is mentioned. N.E.N.

N71-13003# Joint Publications Research Service, Washington, D.C.

TECHNICAL-MILITARY DESIGN OF ELEMENTS OF MISSILE COMPLEXES, PART 2

In its Design and Testing of Ballistic Missiles 19 Nov. 1970 p 242-322 (See N71-13001 03-31)

Avail: NTIS

The principles determining the general characteristics of a missile complex, including combat deployment, are discussed. Mathematical optimization methods used in designing missile complexes and methods of determining cost and reliability are described. Details are given on the optimization of combat range, missile power and launch precision, and stationary and mobile complexes. Program development, and missile complexes under conditions of retaliation are also considered. N.E.N.

N71-13004# Joint Publications Research Service, Washington, D.C.

EXPERIMENTAL DEVELOPMENT AND TESTING OF MISSILES, PART 3

In its Design and Testing of Ballistic Missiles 19 Nov. 1970 p 323-395 (See N71-13001 03-31)

Avail: NTIS

The importance of testing and experimental development for reliability is discussed. It is felt that the viability and required features are ensured by incorporating gradual changes in the design during development. Guidelines are presented for the evaluation of reliability and effectiveness of missiles and missile systems. Static and dynamic tests, procedures, and determination of the static and dynamic loads, temperature fields, and aerodynamic characteristics are described. N.E.N.

N71-13026*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SIMULATION AND ANALYSIS OF PANEL SEPARATION FROM THE APOLLO 13 SERVICE MODULE

H. Wayne Leonard, Martin M. Mikulas, Jr., Homer G. Morgan, and William R. Cofer Washington Dec. 1970 61 p ref

(NASA-TN-D-6087; L-7426) Avail: NTIS CSCL 22B

An experimental and analytical program was conducted to simulate the separation of the service module bay 4 cover panel from the Apollo 13 spacecraft which occurred during its flight accident. The study was also intended to establish failure mechanisms, pressure distributions, and pressure time histories that would explain the essentially complete separation that was observed in the photographs taken by the Apollo 13 crew. One-half-scale dynamic models of the cover panel were tested on a boilerplate test fixture that simulated the internal free volume and venting of the service module. Both isotropi. and sandwich panel models were studied, and tests were conducted in atmosphere and in a vacuum chamber. Panel loadings were provided by a pressurization system that rapidly released air into the oxygen shelf space of the service module bay 4 at the location of the number 2 oxygen tank. Both static and dynamic structural analyses were conducted in support of the tests. Author

N71-13044# Joint Publications Research Service, Washington, D.C.

TASS GIVES DETAILED REPORT ON FLIGHT OF LUNA 16, APPENDIX

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space , No. 239 28 Oct. 1970 p 78-92 (See N71-13038 03-34)

Avail: NTIS

The Luna-16 flight is reported. The automatic station is described as consisting of a landing stage with a soil drilling device, and a moon-to-earth space rocket with a return vehicle. The actual flight is reported in the following stages: (1) the launch and flight to the moon, (2) work on the lunar surface, (3) return to earth, and (4) the lunar soil on earth. F.O.S

N71-13061# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

UNMANNED FLIGHT VEHICLES

P. M. Afonin et al 17 Aug. 1970 597 p refs Transl. into ENGLISH from Bespilotnye Letatelnye Apparaty (Moscow), 1967 p 1-439

(AD-713035; FTD-MT-24-117-70) Avail: NTIS CSCL 16/4

Principles of the aerodynamics and the dynamics of flight of unmanned flight vehicles are briefly stated. Their design is described, and some information is given about flight control systems, and also about the equipment and principles of operation of reaction engines, about warheads of guided missiles, and about the ground equipment. Methods of the estimation of combat effectiveness of guided missiles are given. Author (TAB)

N71-13065+ Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DYNAMICS OF THE DESIGN OF A FLIGHT VEHICLE

V. F. Gladkii 5 Aug. 1970 610 p refs Transl. into ENGLISH from Dinamika Konstruktsii Letatelnogo Apparata (Moscow), 1969 p 1-495

(AD-712822; FTD-MT-24-67-70) Avail: NTIS CSCL 16/4

The book is devoted to the problem of determining the necessary carrying capacity and rigidity of design of a flight vehicle. Discussed in it are theoretical bases and practical methods of the calculation of internal force factors from external forces acting on the vehicle in the process of operation, and methods of development of calculation cases of loading are given. In this case the main attention is given to problems of the dynamics of design, in particular the selection of design configurations, the formulation of equations of dynamic equilibrium and determination of the dynamic reaction of design on the effect of external perturbations. Consideration is given to those limitations which are imposed by conditions of strength of the design on values of certain parameters of the propulsion system, automatic control system, complex of ground equipment, and also on conditions of operation of flight vehicles of different types. Author (TAB)

N71-13073*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

APOLLO 13 MISSION REPORT

Sep. 1970 160 p refs

(NASA-TM-X-66449; MSC-02680) Avail: NTIS CSCL 22A

The Apollo 13 mission, planned as a lunar landing in the Fra Mauro area, was aborted because of an abrupt loss of service

module cryogenic oxygen associated with a fire in one of the two tanks at approximately 56 hours. The lunar module provided the necessary support to sustain a minimum operational condition for a safe return to earth. A circumlunar profile was executed as the most efficient means of earth return, with the lunar module providing power and life support until transfer to the command module just prior to entry. Although the mission was unsuccessful as planned, a lunar flyby and several scientific experiments were completed. Author

N71-13074*# Rensselaer Polytechnic Inst., Troy, N.Y.
MARS ROVING VEHICLE CONFIGURATION
Wilson Parker Rayfield Aug. 1970 35 p refs
(Grant NGL-33-018-091)
(NASA-CR-111560; RPI-TR-MP-18) Avail: NTIS CSCL 22B

A simple, single-module unmanned Mars roving vehicle with flexible metal toroidal hoop-spoked wheels is proposed and analyzed. Concentrating gross weight over the two individually -controlled rear traction wheels facilitates wagon steering and obstacle negotiation, and permits turning and maneuverability within a small area. A remote-controlled model based on similitude was designed and fabricated to simulate on earth the static and dynamic responses of the full-size vehicle on Mars. Author

N71-13077*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF TWO MAGNETOMETERS FOR MAGNETIC FIELD MEASUREMENTS ON A SPACECRAFT
Norman F. Ness, Kenneth W. Behannon, Ronald P. Lepping, and Kenneth H. Schatten Oct. 1970 30 p refs Submitted for publication
(NASA-TM-X-65386; X-690-70-416) Avail: NTIS CSCL 22B

The accurate in situ measurement of the weak magnetic fields in interplanetary space and near the moon and planets by satellites, has often been limited more by the spacecraft generated magnetic field than by the zero level stability of the magnetometer or the quantization uncertainty of the telemetry data readout system. A new method is proposed for obtaining accurate results even in the presence of a large and variable spacecraft field. The method uses simultaneous data from two magnetometers whose sensors are placed at different positions along a moderately long boom. The analysis of the data yields a continuous measure of the spacecraft field and the unknown field in space. The accuracy is determined by the validity of assumptions concerning the spacecraft field and the zero level drifts of the sensors. It is assumed that the external field to be measured is spatially uniform on the distance scale of the sensors' separation distance. This method can be used on both spin stabilized and fixed attitude spacecraft. Author

N71-13078*# National Aeronautics and Space Administration, Washington, D.C.
ASSESSMENT AND CONTROL OF SPACECRAFT MAGNETIC FIELDS
Sep. 1970 30 p refs
(NASA-SP-8037) Avail: NTIS CSCL 22B

The magnetic fields caused by sources aboard a spacecraft are of concern because of their effects on sensitive equipment and experiments. A mission objective common to many scientific spacecraft is the measurement of natural magnetic fields. The instruments used for these measurements will detect not only the ambient magnetic field but also the magnetic field of the spacecraft. Thus, the spacecraft magnetic field must be kept below a certain limit to prevent interference. This design criteria monograph provides guidance for assessment of magnetic effects and control of adverse effects in spacecraft design, development, and testing. The degree of control depends on the mission objective. For instance, stringent requirements for stability of the spacecraft remanent magnetic field would be necessary when the mission involves measurement of the weak ambient fields of interplanetary space. For measurement of the strong fields near Earth and Jupiter, however, less rigid control requirements usually are acceptable. Control requirements could be severe, however, for near Earth spacecraft that measure small perturbations of the magnetic field or use magnetometers for attitude determination. Author

N71-13087*# Bell Aerospace Co., Buffalo, N.Y.
A STUDY OF AIR CUSHION LANDING SYSTEMS FOR SPACE SHUTTLE VEHICLES
John M. Ryken Dec. 1970 143 p refs
(Contract NAS1-9992)
(NASA-CR-111803) Avail: NTIS CSCL 22B

A study was made to determine the feasibility of using an air cushion landing system (ACLS) instead of conventional landing gear, on space shuttle boosters and orbiters. Results indicate that such a system is feasible and that its weight will be less than the weight of conventional gear. Volume requirements and aerodynamic effects will be comparable to those of conventional gear. If air cushion landing system parameters are properly selected, a small structural weight saving may be possible. Materials are available for externally stowed trunks on boosters, but orbiter trunks must be stowed internally or otherwise protected. Author

N71-13100*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
VEHICLE-SCALE INVESTIGATION OF A FLUORINE-HYDROGEN MAIN TANK INJECTION PRESSURIZATION SYSTEM Final Report, 1 Jul. 1969 - 31 Jul. 1970
E. C. Cady and D. W. Kendle 31 Jul. 1970 223 p refs
(Contract NAS3-13306)
(NASA-CR-72756; MDC-G0805) Avail: NTIS CSCL 21H

A comprehensive analytical and experimental program is described that resulted in an advanced computerized analytical technique for predicting the performance of a fluorine-hydrogen main tank injection (MTI) pressurization system for the full range for LH2 - fueled space vehicles. The accuracy of the analysis was verified by a series of 17 tests of a full-scale MTI pressure control system in a 1000 cu ft flight-weight LH2 tank. Prepressurization, constant-pressure hold, and LH2 expulsion at controlled tank pressure were demonstrated over a wide range of ullage volumes, flowrates, tank pressures, and injector configurations, with reasonable ullage gas and tank wall temperatures and efficient fluorine usage. Author

N71-13101# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Propulsion Dept.
PROCEEDINGS OF LOW-G SEMINAR
J. B. Blackmon, ed. May 1969 210 p refs Seminar on Low-Gravity Fluid Dyn. and Propellant Control, 24-25 Oct. 1968; sponsored by McDonnell Douglas Astronaut. Co., Western Div.
(DAC-63140) Avail: NTIS

CONTENTS:

1. THE RESPONSE OF S-4B LOX TANK CONDITIONS TO VEHICLE PERTURBATIONS P. W. Garrison and M. L. Joy p 1-12 refs (See N71-13102 03-27)

2. LOW-DELTA G BUBBLE BEHAVIOR R. A. Madsen and J. N. Castle p 13-24 refs (See N71-13103 03-27)

3. VAPOR VOLUME ENTRAINED IN THE BULK OF THE LIQUID DUE TO BOUNDARY LAYER BOILING IN A LOW-GRAVITY FIELD J. Nevickas and H. R. Melton p 25-37 refs (See N13104 03-27)

4. SATURN S-4B PROPELLANT BEHAVIOR R. N. Salzman and J. C. Wood p 39-49 refs (See N71-13105 03-27)

5. SLOSH WAVE AMPLIFICATION R. N. Salzman p 51-61 refs (See N71-13106 03-27)

6. PRESSURIZATION COLLAPSE IN CRYOGENIC PROPELLANT TANKAGE DUE TO SUB-SURFACE VAPOR

BUBBLES R. K. Weegar p 63–71 refs (See N71-13107 03-27)

7. A VISUAL STUDY OF PROPELLANT DESTRATIFICATION F. W. Thomas and L. A. Holmes p 73–80 refs (See N71-13108 03-27)

8. AN EXPERIMENTAL STUDY OF THE EFFECTS OF LOW BOND NUMBER SLOSHING ON THERMAL STRATIFICATION L. A. Holmes and R. J. Krane p 81–99 refs (See N71-13109 03-27)

9. FEASIBILITY OF ROTATIONAL DESTRATIFICATION OF SPACE-STORED LIQUID CRYOGENS I. Catton p 101–107 refs (See N71-13110 03-27)

10. PRESSURIZATOON GAS FLOW EFFECTS ON LIQUID INTERFACE INSTABILITY J. B. Blackmon p 109–117 refs (See N71-13111 03-27)

11. TANK PRESSURIZATION D. W. Kendle p 119–134 refs (See N71-13112 03-27)

12. THERMODYNAMIC VAPOR-LIQUID SEPARATOR E. C. Cady p 135–146 refs (See N71-13113 03-27)

13. MOL PROPELLANT GAUGING SYSTEM J. Bliss p 147–153 (See N71-13114 03-27)

14. POSITIVE POSITIVE EXPULSION SYSTEMS: DELTA A STATE OF THE ART SURVEY H. M. Hanson and T. J. Schweitzer p 155–164 ref (See N71-13115 03-27)

15. MECHANICS OF BLADDER INVERSION R. R. Myer p 165–169 (See N71-13116 03-32)

16. APPLICATIONS OF THE MARKER-AND-CELL NUMERICAL PROGRAM C. R. Easton p 171–181 refs (See N71-13117 03-12)

17. PROPELLANT SETTLING J. B. Blackmon, J. N. Castle, and B. R. Heckman p 183–195 refs (See N71-13118 03-27)

18. SURFACE TENSION AND DIELECTROPHORESIS J. N. Castle p 197–206 refs (See N71-13119 03-27)

N71-13241# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

UNMANNED MISSILES AND SPACECRAFT

I. S. Golubev et al 19 Aug. 1970 488 p refs Transl. into ENGLISH from Besdilotnye Letatelnyye Apparaty (Moscow), 1967 p 1–440

(AD-713032; FTD-HC-23-301-69) Avail: NTIS CSCL 16/4

Briefly discussed are the principles of aerodynamics and flight dynamics of unmanned missiles. Their structure is described and some information is presented on flight control systems as well as on the design and operating principles of reaction engines, on the warheads of guided missiles, and on the ground installations. Methods are given for evaluating the combat efficiency of guided missiles. Author (TAB)

N71-13251# Laboratoire d'Automatique et de ses Applications Spatiales, Toulouse (France).

CONTRIBUTION TO THE SYNTHESIS OF CONTROL SYSTEMS FOR SATELLITE STABILIZATION USING ION MICROTHRUSTORS [CONTRIBUTION A LA SYNTHESE DE SYSTEMES DE COMMANDE POUR LA STABILISATION D'UN SATELLITE A L'AIDE DE MICROPROPULSEURS IONIQUES]

Alain Costes and Jean Claude Laprie [1969] 66 p refs In FRENCH; ENGLISH summary

Avail: NTIS

The NTIS of using cesium contact-ion microthrustors with beam deflection were investigated. The performances obtained with optimal and sub-optimal laws in terms of the constraints imposed by the selected exhaust device were examined for the reduction to zero of the velocity components of a rigid spin-stabilized, symmetrical satellite. In the case of the sub-optimal laws, a logic structure less complex than that of the usual bang-bang control system was developed. Author (ESRO)

N71-13252# European Space Research and Technology Center, Noordwijk (Netherlands).

AUXILIARY CIRCUITS AND POWER SYSTEM PERFORMANCE ANALYSIS

A. Werner Preukschat Nov. 1969 27 p refs

(ESRO-TM-109-ESTEC) Avail: NTIS

An introduction is given to in-flight power system performance analysis. The measurement techniques requiring auxiliary circuits are briefly discussed. From an analysis of the interface between system units the requirements for performance evaluation are derived. The requirements for a ground evaluation facility and its components are outlined; a possible solution to the problem of performance analysis in flight is indicated. Author (ESRO)

N71-13253# European Space Research and Technology Center, Noordwijk (Netherlands).

A DOMAIN MODEL FOR COMPUTER SIMULATION OF FERROMAGNETIC HYSTERESIS

R. Kammuller Dec. 1969 83 p refs

(ESRO-SR-12-ESTEC) Avail: NTIS

A theoretical model consisting of a pair of single domains which interact magnetically, was used to describe the magnetic equilibrium of a ferromagnetic body in a homogeneous magnetic field. The magnetization curve of the elementary domain pair is characterized by its switch points, where the spontaneous and irreversible change of the domain magnetization takes place. For the calculation of the statistical mean magnetization, the switch points of the domains have to be memorized. General rules for the creation and completion of hysteresis subloops in the B/H plane were derived and resulted in a number of sensitive procedures for testing theoretical models of ferromagnetic materials. These techniques have been used for digital simulation of the attitude motion of the ESRO 1 satellite. Author (ESRO)

N71-13259# Technische Hochschule Stuttgart (West Germany). Inst. fuer Kernenergetik.

OPTIMIZATION OF PLANE FIN-TUBE RADIATORS FOR SPACECRAFT ENERGY SUPPLY [OPTIMALE AUSLEGUNG VON EBENEN RIPPENROHR-RADIATOREN FUER ENERGIEVERSORGUNGSANLAGEN VON RAUMFLUGGERAETEN]

Guenter Woessner (Ph.D. Thesis) 1970 164 p refs In GERMAN

Avail: NTIS

The optimal design of a cooling circuit for a spacecraft power supply with plane fin-tube radiators is investigated regarding minimal mass/electric power ratio. As pressure losses decisively influence the optimal design of the radiator equipment the determination of flow behavior in the radiator tube register is extensively treated. ESRO

N71-13260# Technische Hochschule Stuttgart (West Germany). Inst. fuer Kernenergetik.

CALCULATION OF THE REFLECTION AND OPTIMIZATION OF PLANE FIN-TUBE RADIATORS CONSIDERING USE OF COATINGS [BERECHNUNG DER ABSTRAHLLEISTUNG UND OPTIMIERUNG DES EBENEN RIPPENROHR-RADIATORS MIT BERUECKSICHTIGUNG DER VERWENDUNG VON UEBERZUEGEN]

Ernst Tetzlaff (Ph.D. Thesis) 1969 108 p refs In GERMAN

Avail: NTIS

A plane fin-tube radiator for a spacecraft nuclear power system is calculated and optimized. Particular attention is paid to increasing the radiative heat transfer per mass unit by using fins and high emissivity coatings on the radiation surfaces for beryllium radiators. The design data referring to the coolant flow and the meteorite protection are varied in the range of interest for space radiators. ESRO

N71-13276 Lockheed Missiles and Space Co., Palo Alto, Calif.

INTERKOSMOS-1 IN ORBIT

I. P. Tindo et al [1970] 17 p refs Transl. into ENGLISH from Priroda (Moscow), no. 4, 1970 p 78–87

Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Experiments and instrumentation of Intercosmos-1 satellite launched 14 October 1969 are discussed. Solar radiation was measured using Lyman-alpha and X-ray photometers. X-ray images of the corona, a cosmic X-ray television set, and beams or Maxwell tails are also examined. J.A.M.

N71-13298*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA SYSTEM SUPPORT FOR THE PIONEER PROJECT. VOLUME 4: PIONEER 9 PRELAUNCH THROUGH JUNE 1969
N. A. Renzetti 15 Nov. 1970 215 p refs
(Contract NAS7-100)
(NASA-CR-111561; JPL-TM-33-426-Vol-4) Avail: NTIS CSCL 22A

The Pioneer IX mission (inward trajectory and heliocentric orbit) employed seven scientific instruments to accumulate information relative to interplanetary high-energy particles, solar phenomena, and plasma. The launch vehicle carried aloft a piggyback satellite called the Test and Training Satellite to be used for Apollo ground station crew training and mission simulation. The spacecraft also served as a celestial mechanics experiment reference point. In addition, a convolutional coding experiment was conducted. The Tracking and Data System tracked the spacecraft from launch through the near-earth and deep space phases of the mission. For near-earth tracking, all Tracking and Data System facilities responded to the mission, launch-vehicle, and range requirements. For deep space tracking, the Deep Space Network responded to the tracking, telemetry, command, monitoring, simulation, and operations control requirements. The Pioneer E mission (near the earth for 900 days, then heliocentric) was intended to investigate interplanetary phenomena. After 438 s of flight on August 27, 1969, a destruct signal was transmitted because of a loss of hydraulic pressure in the first stage. This was the fifth spacecraft in the second Pioneer generation and the only failure (launch vehicle failed). Author

N71-13317# European Space Operations Center, Darmstadt (West Germany).
RECONSTITUTION OF THE ROUGH THRUST CURVE OF A ROCKET FROM THE FLIGHT DATA
H. Kummer Paris ESRO Jun. 1968 42 p ref
(ESRO-TN-17-ESOC) Avail: NTIS

A method of determining the thrust curve of a two-stage rocket from the flight data is described. The following quantities must be known: the masses at ignition and after burn-out of each of the two stages; the quantities characterising the air drag of the vehicle as a function of the Mach number; the initial elevation and velocity; the geometry of the rocket; and finally the slant range as a function of time. A real thrust curve is elaborated which, for the atmospheric model assumed, imparts to the rocket a flight path such that the slant range given is approximated in the sense of least squares. No account is taken of influences due to wind or the rotation of the earth (Coriolis forces) which may affect the flight path. A Skylark rocket thrust curve is discussed and the computer output is reproduced. Author (ESRO)

N71-13318# European Space Research and Technology Center, Noordwijk (Netherlands).
LINEAR VOLTAGE PULSE-WIDTH/AMPLITUDE CONVERTER [CONVERTISSEUR LINEAIRE TENSION-LARGEUR D'IMPULSION]
A. Capel and A. W. Preukschat Paris ESRO Mar. 1970 35 p refs In FRENCH; ENGLISH summary
(ESRO-TN-101-ESTEC) Avail: NTIS

A circuit for highly linear wide-range voltage amplitude/pulse-width conversion usin a monostable coupled-emitter and a constant-current source is described. Other advantages are low control-voltage-level requirements, low output impedance, high reliability, temperature compensation and a wide range of pulse-width variation. The circuit operation is discussed and major design equations are derived. The linearity of conversion is 0.8 per cent of full-scale pulse width. The total number of active components is 5. The pulse width can be controlled by changing the value of a capacitance from a few nsec up to 60 msec for a control voltage variation of 1.8 V to 4.0 V. Author (ESRO)

N71-13320# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Maschinenbau.
INVESTIGATIONS ON THE USE OF AIR-BREATHING BOOSTERS FOR THE PROPULSION OF THE FIRST STAGE OF A SPACE VEHICLE [UNTERSUCHUNGEN ZUR FRAGE DER ANWENDBARKEIT LUFTATMENDER TRIEBWERKE ALS ANTRIEB DER ERSTEN STUFE EINES RAUMTRANSPORTERS]
Gunter Lenke (Ph.D. Thesis) 1969 119 p refs In GERMAN
Avail: NTIS

Propulsion systems for the first stage of recoverable spacecraft are investigated theoretically. The influence of essential design parameters is taken into account. For a two-stage aerodynamic space shuttle, air breathing and rocket propulsion are compared regarding payload mass ratio. Using an energy balance method, the flight path up to separation of the second stage is optimized in view of fuel consumption. For further ascent of the H2/O-rocket-propelled second stage into circular orbit at 200 km height, ballistic trajectories are calculated. ESRO

N71-13321# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).
FEASIBILITY STUDY FOR THE DEVELOPMENT OF A VAPORIZING-LIQUID-FUEL GAUGE
E. Fraga and A. Munoz Torralbo Paris ESRO Jul. 1970 113 p refs
(Contract ESTEC-681/69AA)
(ESRO-CR-19) Avail: NTIS

Possible methods of gaging, under weightlessness, the amount of vaporizing liquid propellant e.g. ammonia, propane, contained in small spherical tanks are discussed. A gaging principle relying on the gas law and a capacitive gaging system with skin-mounted electrodes, are described. Author (ESRO)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N71-12725# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Unternehmensbereich Raumfahrt.
DAMPING OF SATELLITE STRUCTURES: TECHNICAL POSSIBILITIES AND PRACTICAL EXPERIENCE DEMONSTRATED ON HEOS A1 AND DIAL SATELLITES [DAEMPFUNG VON SATELLITENSTRUKTUREN: TECHNISCHE MOEGLICHKEITEN UND PRAKTISCHE ERFAHRUNGEN AN DEN BEISPIELEN HEOS A1 UND DIAL]
E. D. Sach *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 3 1970 50 p refs In GERMAN (See N71-12719 03-11)
Avail: NTIS

Vibration damping methods using plastic and liquid dampers, vibration absorbers and viscoelastic lasers, used for the limiting of resonance overloading of satellites, are described. To illustrate performance and installation, simple examples are selected and calculated. Trial results of damping systems for the projects HEOS A1 and DIAL are given. ESRO

N71-12734*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VARIABLE-SWEEP-RATE TESTING: A TECHNIQUE TO IMPROVE THE QUALITY AND ACQUISITION OF FREQUENCY RESPONSE AND VIBRATION DATA
Carl F. Lorenzo Washington Dec. 1970 25 p refs
(NASA-TN-D-7022; E-5804) Avail: NTIS CSCL 13M

A technique has been established to improve the quality and reduce the acquisition time of frequency response and vibration data. The technique involves sweeping at a variable rate which is slow during periods of dynamic importance and fast other times. A closed-loop controller senses system resonance and adjusts a basic sweep rate appropriately. Base sweeps which were linear and logarithmic with time were considered. With both methods significant improvements in sweep time and data quality have been shown. Author

N71-12751# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Bauingenieurwesen.
CALCULATION OF THE BENDING MOMENTS OF TRANSVERSE CONTINUOUS RECTANGULAR PLATES WITH A MATRIX ALGORITHM [EIN MATRIZENALGORITHMUS ZUR BERECHNUNG DER BIEGEMOMENTE KREUZWEISE DURCHLAUFENDER RECHTECKPLATTEN]
Peter Reiche (Ph.D. Thesis) 1969 91 p refs In GERMAN
Avail: NTIS

An algorithm for calculation of the bending moments of plates is derived with matrix methods. The plates lie on vertically rigid bearings. The amount of plates and the form of the total system is arbitrary. Every plate has an arbitrary but constant thickness and is loaded arbitrarily. An equation system for Fourier coefficients is developed and the coefficient matrix is subdivided into partial matrices, for which a matrix algorithm is designed. The algorithm is solved in FORTRAN 4 on an IBM 7094. It is shown that the supporting moments of larger systems may be precisely calculated using systems consisting of 4 x 4 plates. ESRO

N71-12869# Technion-Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
RECENT EXPERIMENTAL STUDIES ON THE BUCKLING OF INTEGRALLY STRINGER-STIFFENED CYLINDRICAL SHELLS
Tanchum Weller, Josef Singer, and Shimon Nachmani Apr. 1970 61 p refs
(Contracts AF 61(052)-905; F61052-69-C-0040)
(AD-712090; TAE-100; AFOSR 70-2389TR; SR-11) Avail: NTIS CSCL 20/11

An experimental study of the buckling of closely spaced, integrally stringer-stiffened, cylindrical shells under axial compression was carried out to determine the influence of stiffener and shell geometry on the applicability of linear theory. Eighty-six shells of different geometries were tested. Agreement between linear theory and experiments was found to be governed primarily by the stringer area parameter (Al/bh). Good correlation was obtained in the range (Al/bh) > 0.4. No significant effect of other stiffener and shell parameters on the applicability of linear theory could be discerned for the specimens tested. In addition to the area parameter (Al/bh), the inelastic behavior of the shell material was found to have a considerable effect on the linearity (ratio of experimental buckling load to the predicted one). Author (TAB)

N71-12949# North Carolina State Univ., Raleigh.
STEADY-PROFILE ANALYSIS OF PLANE SHOCK-STRUCTURES IN SOLIDS Technical Report, 1 Sep. 1967 - 31 Aug. 1970
Yasuyuki Horie Aug. 1970 56 p refs
(Contract N00014-68-A-0187; Proj. Dynamic Material Response)
(AD-712059; TR-70-4) Avail: NTIS CSCL 20/11

Duvall, Manvi, and Lowell have shown a close relationship between a continuum theory of shock-structures in solids and that of one-dimensional lattices. Extending their results, it was shown that the thermodynamical behaviors of shock-structures are equivalent to those of the dissipative autonomous system described by the generalized Lienard equation. The theory assumes the adiabatic conditions and the relaxational transformation of instantaneous work into the equilibrium internal energy. Author (TAB)

N71-12950# Road Research Lab., Crowthorne (England).
EXPERIMENTAL TECHNIQUES FOR DETERMINING SUPPORT REACTIONS IN MODELS OF BEAMS AND SLABS
G. E. Smith 1970 28 p refs
(PB-193783; RRL-LR-322) Avail: NTIS CSCL 13M

Experimental techniques for determining support reactions in structural models of continuous beams and slabs are proposed. The method, which is based on an application of Betti's theorem, does not involve direct measurement of the reactions themselves but merely requires measurement of displacements at various points on the model, which may be mounted on any statically determinate system of rigid supports. The effects on the reactions of settlement or elastic deflection of the supports can readily be taken into account by computation alone, without the need for further measurements. Author

N71-12951# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS Final Report, 10 Mar. 1969 - 31 May 1970
Le-Wu Lu 22 Sep. 1970 8 p refs
(Contract N00024-69-C-5381)
(AD-712121) Avail: NTIS CSCL 13/13

A brief summary is given of the results of an investigation of the plastic behavior of welded multi-story frames and their components, and the development of design methods for such frames based on plastic strength. A list of the 15 publications resulting from the work is included. TAB

N71-12953# Sandia Corp., Albuquerque, N.Mex.
DETERMINATION OF THE SPECIFIC IMPULSE, PRESSURE-TIME PROFILE, AND EXPLOSIVE REFLECTION CHARACTERISTIC FOR A RECONSTITUTED SHEET EXPLOSIVE
R. P. May, R. G. Biesecker, and E. G. Young Aug. 1970 40 p refs
(SC-DR-70-432) Avail: NTIS

A reconstituted DuPont EL-506D sheet explosive, 57 mils thick, was investigated to obtain impulse generation characteristics. The study determined a total specific impulse of 526 taps per mil for the explosive. Pulse shape and attenuation of the pressure wave were measured at depths of 1.0 to 6.4 mm in epoxy. The pressure-time wave shape was found to be nearly exponential in the epoxy and was closely duplicated by calculations using the WONDY 3 computer code. Pressure in three standard materials (copper, aluminum, and plexiglas) induced by a 100 mm thick pad of the explosive gave the explosive reflection characteristic. Calibration of a manganin gage used in the study yielded a gage factor of 0.002354/kbar. Author

N71-12956# Dayton Univ. Research Inst., Ohio.
HOLE GROWTH IN THIN PLATES PERFORATED BY HYPERVELOCITY PELLETS
W. C. Turbin and J. M. Carson Apr. 1970 59 p refs
(Contract F33615-68-C-1138)
(AD-712071; UDRI-TR-70-16; AFML-TR-70-83) Avail: NTIS CSCL 20/11

An experimental study has measured hole growth rates in thin plates impacted by hypervelocity pellets. These hole growth rates were obtained for 0.85 mm thick plates made of aluminum,

copper, and cadmium impacted at 5-7 km/sec with 3.18 mm spheres of like material. The growth process was found to be a two stage process. Results are compared with the numerical predictions from a two dimensional impact code. These dynamic results are combined with observations resulting from a catalog of over 400 hole corpse measurements to form a qualitative model of thin plate impact. Author (USGRDR)

N71-12965*# Midwest Research Inst., Kansas City, Mo.
FASTENER LOAD ANALYSIS METHOD Phase 1 Report, 28 Jan. – 1 Aug. 1970
Fred R. Rollins, Jr. Aug. 1970 32 p refs
(Contract NAS 8-25362; MRI Proj. 3406-C)
(NASA-CR-102929) Avail: NTIS CSCL 20K

The feasibility of analyzing bolt loads by ultrasonic techniques was investigated. Various techniques were evaluated and an interferometric method, called frequency nulling, was selected for experimental testing. In agreement with theoretical predictions the frequency-null response was found to be linearly related to tensile stresses oriented parallel to the bolt axis. Under rather idealized conditions bolt loads can be determined with errors of less than 1%. The ultimate operational accuracy depends on a number of variables, such as bolt dimensions and geometry, temperature, uniformity of stresses, and bolt materials, but load analysis to within + or − 3% is achievable without too much difficulty. Best results are obtained with the ultrasonic transducer contact coupled to the bolt head, and this is facilitated by having a small flat area near the center of the bolt head. The transducer can be applied without interfering with normal wrenching operations. Author

N71-12966# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE EFFECT OF VARIATIONS IN THE CREEP EXPONENT N ON THE BUCKLING OF CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION
Terence C. Honikman and Nicholas J. Hoff Jun. 1970 184 p refs
(Contract-F44620-69-C-0009)
(AD-711949; SUDAAR-396; AFOSR-70-1729TR) Avail: NTIS CSCL 20/11

The purpose of the investigation is to determine the effect of creep on the load carrying capability of axially symmetric circular cylinders when subjected to uniform axial compression. In particular, the effect of variation of the creep exponent in Odqvists bi-axial creep law for creep, is investigated. The analysis of the problem is undertaken in the cases in which the creep exponent has the value one and five. Closed form analytical results are presented for the cases in which the creep exponent has the value one, three, and five. Two numerical procedures are developed. The first generates the governing equations of the creep problem symbolically, while the second solves these equations. Numerical results are presented for the cases in which the creep exponent has the value three, five, seven, and nine. The numerical results are compared with the analytical results. While the numerical programs offer a means of further extending the range of values of the creep exponent, this is carried out instead by two empirical methods, which are based on the numerical results already obtained. The case in which the creep exponent becomes unbounded is considered analytically. Dimensionless plots of radial displacement versus time are presented for each value of the creep exponent, and for a variety of values of initial imperfections in the shell wall. A simple graphical method is developed by which the plot for any given value of the initial imperfection may be obtained from another similar plot for which the value of the initial imperfection is smaller than the given value. Author (TAB)

N71-12967# Brown Univ., Providence, R.I. Div. of Engineering.
A SELF-CONSISTENT POLYCRYSTALLINE MODEL FOR CREEP UNDER COMBINED STRESS STATES
G. M. Brown Jul. 1970 37 p refs
(Contract N00014-67-A-0191-0003)
(AD-712046; TR-9) Avail: NTIS CSCL 20/11

The application of the self consistent polycrystalline model of inelastic deformation has been extended to include time dependent (i.e. creep) behavior. Comparison of the predictions of a simple power law microconstitutive relation in the model with experiments, suggests that an appreciable amount of the observed dependence of behavior on prior history of combined stressing can be explained by grain interaction effects. The existence of a flow potential for the self consistent polycrystalline model is demonstrated, and flow potential surfaces, calculated from a simple power law microconstitutive relation, are shown for several cases of combined tension-torsion deformation. To a good approximation, these surfaces exhibit a kinematic translation in stress space with prior deformation history. Author (TAB)

N71-12988# Institut Franco-Allemand de Recherches, St. Louis (France).
BEHAVIOR OF STEEL PLATES UNDER PRESSURE SHOCK LOADING [RESPONSES DE DALLES EN ACIER SOUMISES A L'ACTION D'UN SOUFFLE]
C. Thery, Ch. Johe, and J.-J. Brunner 1 Oct. 1969 46 p In FRENCH
(ISL-T-40/69) Avail: NTIS

Deformation velocities in square steel plates of constant thicknesses were observed for shock loads of 10 bar peak pressure and median value widths of 100 ms. Self-oscillation frequencies of two elastic deformed plates of about 1 m side lengths and 35 mm thicknesses were much smaller than calculated values; the sidelong deformation was somewhat slower in relationship to the applied pressure. Plastic deformations were observed on two 15 mm plates under the same experimental conditions. It was concluded that deformation velocity depended to an important degree on load velocity. Elongation measurements showed that median deformation developed in the plate center and strong deformations in the boundary zone. Author

N71-12998# Akademiya Nauk URSR, Kiev. Inst. Mekhaniki.
THERMAL STRESS IN CONSTRUCTION ELEMENTS, NO. 9
1970 358 p refs In RUSSIAN Presented at 9th Sci. Conf. on Thermal Stress in Construct. Elem.
Avail: NTIS

Selected articles are presented on quasi-static and dynamic problems of thermoelasticity, thermoviscoelastic mechanics, thermoplasticity, and thermal creep with respect to the stressed state and yield strength of construction elements at high temperatures. The articles are applicable to the field of power machinery construction. Transl. by R.B.

N71-13006# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
ELASTIC RESPONSE OF PRESTRAINED BODIES
William J. Douglas, Walter Jaunzemis, and Juan Kiusalaas Dec. 1969 89 p refs
(Contract AF 49(638)-1425)
(AD-712399; AFOSR 70-1045TR; TR-1) Avail: NTIS CSCL 20/11

The Report surveys the technique of superposing small deformations on large ones. The investigation is confined to elastic response, and explicit expressions for the incremental stress-strain relations are given for isotropy and transverse isotropy. The following problems are discussed: (1) small extensions of cylindrical tubes subjected to finite initial inflation, (2) material stability of undistorted states of a Mooney-Rivlin material, (3) internal buckling of finitely prestrained bodies, (4) formulation of incremental stress boundary conditions, (5) strain gradient theories. Author (TAB)

N71-13020# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
STABILITY OF A RECTANGULAR CYLINDRICAL PANEL, RIGIDLY SEALED ALONG THE EDGES AND LOCATED IN A NONUNIFORM TEMPERATURE FIELD
M. S. Ganeeva [1969] 6 p ref Transl. into ENGLISH from Uch. Zap. Kazansk. Gos. Univ. Im. v. i. (USSR), v. 116, no. 1, 1956 p 41–44
(PB-192227T; AEC-tr-7150) Avail: NTIS CSCL 13M

In nonuniform heating, when the expansion of some particles obstructs the expansion of others, temperature stresses arise in the body. It is evident that these temperature stresses will arise in uniform heating also if the body is reinforced in a certain manner, for instance, in a plate with rigidly reinforced edges. Temperature stresses exert a great effect on the strength and stability of structures; for this reason the study of temperature problems has great significance in many areas of technology. Author (USGRDR)

N71-13023*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTEGRATING-MATRIX METHOD FOR DETERMINING THE NATURAL VIBRATION CHARACTERISTICS OF PROPELLER BLADES
William F. Hunter (M.S. Thesis—Va. Polytech. Inst.) Washington Dec. 1970 73 p refs
(NASA-TN-D-6064; L-5539) Avail: NTIS CSCL 20K

A numerical method is presented for determining the natural lateral vibration characteristics of a rotating twisted propeller blade having a nonuniform, unsymmetrical cross section and cantilever boundary conditions. Two coupled fourth-order differential equations of motion are derived which cantilever the motion of such a beam having displacements in two directions. A development of the integrating matrix, which is the basis of the method of solution, is given. By expressing the equations of motion in matrix notation, utilizing the integrating matrix as an operator, and applying the boundary conditions, the differential equations are integrated and formulated into a eigenvalue problem whose solutions may be determined by various methods. Numerical examples are presented and the computed results are compared with experimental data and exact solutions. Author

N71-13051# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 2, NO. 10, OCTOBER 1970
Oct. 1970 37 p
(AD-712417) Avail: NTIS CSCL 20/11

Contents: Shock design research -- theory or experiment; Short courses; Previews of meetings; Abstracts from the current literature (Analysis and design methods; Excitation; Phenomenology; Experimentation; Components; Systems); Book reviews; and Calendar of events. TAB

N71-13092# Houston Univ., Tex. Cullen Coll. of Engineering.
FORCED LONGITUDINAL VIBRATIONS OF PRISMATIC SLENDER BARS UNDER THE INFLUENCE OF QUADRATIC AND EQUIVALENT VISCOUS DAMPING
A. D. Wilkinson, Jr. Aug. 1970 54 p refs
(Contract Nonr-4492(01))
(AD-712441; TR-25) Avail: NTIS CSCL 20/11

Forced longitudinal vibrations of a prismatic, slender bar with quadratic skin damping and equivalent viscous damping are analyzed. The differential equation of motion with quadratic damping is solved numerically by the method of characteristics. The bar is assumed to be free of stress at one end and subject to sinusoidal motion at the other. Frequency-response curves are plotted for several values of the nonlinear damping coefficient. The equivalent linear system is analyzed by Laplace Transforms and the results are compared with those for the nonlinear system. The damping is linearized by equating the energies dissipated per cycle by quadratic and viscous damping. Author (TAB)

N71-13093*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
USER'S MANUAL FOR A DIGITAL COMPUTER PROGRAM FOR COMPUTING THE VIBRATION CHARACTERISTICS OF RING-STIFFENED ORTHOTROPIC SHELLS OF REVOLUTION
Howard M. Adelman, Donnell S. Catherines, Earl C. Steeves, and William C. Walton, Jr. Washington Dec. 1970 97 p refs
(NASA-TM-X-2138; L-7089) Avail: NTIS CSCL 13M

Detailed information is given on the use of a digital computer program for the calculation of the vibration characteristics of orthotropic shells of revolution with and without ring stiffeners. This information includes input parameter definition and coding format, computing options available to the user, and output definition. Application of the program is illustrated by two sample calculations. Author

N71-13098*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
NONLINEAR DYNAMIC ANALYSIS OF STRUCTURES. VOLUME 1: NONLINEAR DAMPING IN STRUCTURES Final Report
C. S. Chang Jun. 1970 78 p refs
(Contract NAS8-21435)
(NASA-CR-102939; LMSC/HREC-D149171-1-Vol-1; HREC-1435-1-Vol-1) Avail: NTIS CSCL 20K

An analytical and experimental study of the dynamic responses of a structure with nonlinear and nonproportional damping is presented. The analysis shows that the steady-state solution of a structure with damping at its boundary can be obtained from the undamped vibration solutions, and that if nonproportional damping is low, classical normal mode responses are indicated by the derived general solution. The analytical results are used to develop experimental approaches to determine damping properties of substructures or structural elements. Experimental studies are used to demonstrate the validity of developed techniques. Author

N71-13116# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Structures (Mechanical)
MECHANICS OF BLADDER INVERSION
R. R. Myer *In its* Proc. of Low-G Seminar May 1969 p 165–169 (See N71-13101 03-31)
Avail: NTIS

The deformation of rotationally symmetric bladders loaded by symmetric inversion pressures is discussed. Two types of deformation are described: (1) bladder buckling by nonsymmetric deformation and (2) inversion in a rotationally symmetric manner. A quasi-static analysis is performed which equates the work done by the external pressure, which is the driving force, to the plastic work at the hinge, the change in liquid potential, and the elastic energy of the inverted surface. Author

N71-13126# Advisory Group for Aerospace Research and Development, Paris (France).
SYMPOSIUM ON STRUCTURAL OPTIMIZATION
Oct. 1970 397 p refs Conf. held at Istanbul, 8-10 Oct. 1969
(AGARD-CP-36-70) Avail: NTIS

CONTENTS:

1. STRUCTURAL ENGINEERING APPLICATIONS OF MATHEMATICAL PROGRAMMING TECHNIQUES L. A. Schmit, Jr. (Case Western Reserve Univ., Cleveland, Ohio) 30 p refs (See N71-13127 03-32)

2. FEASIBLE DIRECTION METHODS J. Kowalik (Boeing Co.; Seattle, Wash.) 20 p refs (See N71-13128 03-08)

3. THE APPLICATION OF LINEAR PROGRAMMING TECHNIQUES IN THE DESIGN OF OPTIMUM STRUCTURES G. G. Pope (RAE, Farnborough, England) 20 p refs (See N71-13129 03-32)

4. DESIGN OF SHIP STRUCTURES BY MEANS OF NON-LINEAR PROGRAMMING TECHNIQUES J. Moe (Technical Univ. of Norway, Trondheim) 30 p refs (See N71-13130 03-32)

5. OPTIMIZATION UNDER AEROELASTIC CONSTRAINTS W. H. Weatherill, H. Ashley, and S. C. Mc Intosh, Jr. (Stanford Univ., Calif.) 30 p refs (See N71-13131 03-32)

6. AUTOMATED ANALYSIS AND EFFICIENT DESIGN OF REAL STRUCTURES I. C. Taig (British Aircraft Corp., Preston, England) 25 p refs (See N71-13132 03-32)

7. CONVERGENCE IN FULLY-STRESSED DESIGNING R. J. Melosh (Philco-Ford Corp., Palo Alto, Calif.) 17 p refs (See N71-13133 03-32)

8. PRACTICAL APPLICATION OF FINITE ELEMENT METHODS IN THE DESIGN OF STRUCTURES M. Flemming (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) 27 p refs (See N71-13134 03-32)

9. THE ROLE OF OPTIMIZATION IN THE DESIGN OF AIRCRAFT STRUCTURES R. A. Gellatly (Bell Aerosystems Co., Buffalo, N.Y.) 18 p refs (See N71-13135 03-32)

10. ON THE MINIMUM MASS LAYOUT OF TRUSSES P. Pedersen (Technical Univ., Copenhagen, Denmark) 19 p refs (See N71-13136 03-32)

11. STRUCTURAL OPTIMIZATION OF A SUPERSONIC HORIZONTAL STABILIZER J. R. Johnson (AFSC, Wright-Patterson AFB, Ohio) and D. S. Warren (Douglas Aircraft Co., Santa Monica, Calif.) 19 p refs (See N71-13137 03-32)

12. OPTIMUM THERMOSTRUCTURAL DESIGN OF THIN CIRCULAR CYLINDERS E. Vallerani (FIAT S. P-A, Turin, Italy) 28 p refs (See N71-13138 03-32)

13. APPLICATIONS OF COMPUTER GRAPHICS IN STRUCTURAL DESIGN W. J. Batdorf (Lockheed-Georgia Co., Marietta) 24 p refs (See N71-13139 03-08)

14. MAN-MACHINE INTERACTIVE STRUCTURAL ANALYSIS AS A PRELIMINARY-DESIGN AID G. A. Butlin (Leicester Univ., England) 28 p refs (See N71-13140 03-32)

15. DESIGNING DISC PROFILES FOR A GAS TURBINE ENGINE USING AN INTERACTIVE GRAPHIC DISPLAY DEVICE M. A. Bayfield (Rolls-Royce, Ltd., Derby, England) 13 p refs (See N71-13141 03-08)

16. OPTIMIZATION OF STRUCTURES WITH RELIABILITY CONSTRAINTS F. Moses (Case Western Reserve Univ., Cleveland, Ohio) 21 p refs (See N71-13142 03-32)

17. THE OPTIMUM DESIGN OF SHELL STRUCTURE FOR STATIC STRENGTH, STIFFNESS, FATIGUE AND DAMAGE TOLERANCE STRENGTHS W. J. Crichlow (Lockheed-California Co., Burbank) 32 p refs (See N71-13143 03-32)

N71-13127# Case Western Reserve Univ., Cleveland, Ohio.

STRUCTURAL ENGINEERING APPLICATIONS OF MATHEMATICAL PROGRAMMING TECHNIQUES

Lucien A. Schmit, Jr. *In* AGARD Symp. on Structural Optimization Oct. 1970 (See N71-13126 03-32) 30 p refs

(Grant NsG-110-61)

Avail: NTIS

It is becoming widely recognized that many common and important problems of practical significance in structural engineering may be effectively treated using mathematical programming techniques. A framework intended to facilitate understanding and enhance insight into this diverse and growing body of information and experience is set forth. At the outset, the distinction between finite optimization problems, to which mathematical programming techniques may be applied, and analytic optimization problems, in which the goal is to find the form of one or more functions, is made. It is suggested that three of the more important bases for characterization of a structural design philosophy are: (1) classification as to whether it is deterministic or probability based; (2) identification of the kinds of failure modes guarded against and; (3) classification with respect to the kinds of load conditions considered. A useful distinction is made between mathematical programming applications in structural analysis and applications to the quantifiable portion of the structural design process. The various kinds of design variables and analysis variables that arise in structural engineering applications of mathematical programming techniques are discussed. Author

N71-13129# Royal Aircraft Establishment, Farnborough (England). Analysis and Optimization Section.

THE APPLICATION OF LINEAR PROGRAMMING TECHNIQUES IN THE DESIGN OF OPTIMUM STRUCTURES

G. G. Pope *In* AGARD Symp. on Structural Optimization Oct. 1970 20 p refs (See N71-13126 03-32)

Copyright. Avail: NTIS

Various procedures for the reduction of non-linear programming problems to a sequence of problems in linear programming are reviewed with special reference to their applicability in the structural design field. The use of the move limit method in the design of stressed-skin structures is described including the incorporation of some simple but important classes of buckling constraints. Design applications that are strictly problems in linear programming are also discussed. Author

N71-13130# Technical Univ. of Norway, Trondheim. Dept. of Ship Structures.

DESIGN OF SHIP STRUCTURES BY MEANS OF NON-LINEAR PROGRAMMING TECHNIQUES

Johannes Moe *In* AGARD Symp. on Structural Optimization Oct. 1970 30 p refs (See N71-13126 03-32)

Avail: NTIS

Discussed are various methods by which the required number of redesigns during the search for optimum as well as the computer work involved in each such redesign may be reduced. Approximate behaviour and constraint models in terms of simple polynomials have been used with considerable success and may be combined with an extrapolation technique that allows one to reduce significantly the number of response surfaces. In this manner the required computer time may be reduced to only a fraction of that previously experienced. A few examples of typical applications to practical ship design problems are presented: (1) minimum cost design of a typical tank section of an oil-tanker; (2) minimum cost design of the midship section of a car-carrier and (3) minimum weight design of grillages and transverse frames of tankers. Author

N71-13131# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

OPTIMIZATION UNDER AEROELASTIC CONSTRAINTS

Warren H. Weatherill (Boeing Co., Seattle), Holt Ashley, and S. C. Mc Intosh, Jr. *In* AGARD Symp. on Structural Optimization Oct. 1970 30 p refs (See N71-13126 03-32)

Avail: NTIS

Limitations are placed on some dynamic or aeroelastic eigenvalue of an aeronautical structure of prescribed shape, topology and overall dimensions. It is then attempted to minimize the rigidity-determining mass or some other related figure of merit. A fairly comprehensive literature survey is included. The cases analyzed to date have fallen into two rather idealized categories. With few exceptions, these examples have involved a single constraint, such as fixed fundamental frequency of vibration, speed of torsional divergence or speed of flutter. On the one hand, situations have been treated involving a one-dimensional structure (bar, beam, rod) governed by a simple ordinary differential equation. On the other, finite-element or modal idealizations of more elaborate configurations have led to optimal solutions on nonlinear algebraic or transcendental systems. Both approaches are capable of generalization, e.g., by the addition of other simultaneous constraints. But the finite-element approach shows greater promise for practical applications. Author

N71-13132# British Aircraft Corp., Preston (England).
AUTOMATED ANALYSIS AND EFFICIENT DESIGN OF REAL STRUCTURES
I. C. Taig *In* AGARD Symp. on Structural Optimization Oct. 1970 25 p refs (See N71-13126 03-32)
Avail: NTIS

The development of computer facilities to aid the efficient design of aircraft structures is considered. Practical aspects of an automated design system not normally covered in analytical treatments of the subject are discussed. Particular attention is given to the need to make vital decisions early in the design period, to the kind of information which will contribute to sound decisions and to the most profitable developments in computing facilities to meet these needs. Described is a particular system for automated analysis and design which aims to meet these requirements by progressive improvement of procedures already in use in a design office. The main developments are an engineering communication language, its application to problem specification and optimum structural design and the integration of analysis and design by automated idealisation. In a brief review of the present level of development and application to design it is concluded that the most urgent improvements needed are the full integration of the system, the addition of graphic imput facilities and the study of the criteria used to assess structure merit. Author

N71-13133# Philco-Ford Corp., Palo Alto, Calif. Western Development Labs.
CONVERGENCE IN FULLY-STRESSED DESIGNING
Robert J. Melosh *In* AGARD Symp. on Structural Optimization Oct. 1970 17 p refs (See N71-13126 03-32)
Avail: NTIS

The fully-stressed design process is alleged to be a means for efficient development of structural designs of adequate strength and low weight. A small general problem is examined in detail. Optimality, convergence, and convergence rate of fully-stressed designing are examined. Modifications of the process are described to treat discrete sizes, multiple degree of freedom elements, group sizes, and convergence characteristics. These improvements are shown to reduce the number of design cycles by an order of magnitude on sensitive problems. It is concluded that the fully-stressed design process obtains designs efficiently, often produces a fully-stressed design, but generally produces a design of dubious merit. Author

N71-13134# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PRACTICAL APPLICATION OF FINITE ELEMENT METHODS IN THE DESIGN OF STRUCTURES
M. Fleming *In* AGARD Symp. on Structural Optimization Oct. 1970 27 p refs (See N71-13126 03-32)
Avail: NTIS

A comparison between test- and theoretical results using the finite element method is given and the numerical stability of this method is considered. Results of static and dynamic calculations are shown. Structural problems which occured in the VTOL-technique and their solution with the displacement method are explained. Author

N71-13135# Bell Aerosystems Co., Buffalo, N. Y. Structural Systems Dept.
THE ROLE OF OPTIMIZATION IN THE DESIGN OF AIRCRAFT STRUCTURES
Ronald A. Gellatly *In* AGARD Symp. on Structural Optimization Oct. 1970 18 p refs (See N71-13126 03-32)
Avail: NTIS

The long term goal in structural research is the development of integrated design procedures whereby the engineer-analyst and the computer perform complementary interactive roles in the total design process. As a first major step toward this goal the methodology of structural optimization has been evolved. Although developed principally to perform the automatic design of optimum structures, these procedures have been extended into all aspects of preliminary structural design. With these computational tools, the designer is now enabled to make analytically based quantitative and qualitative judgments on the relative merits of various candidate configurations necessary to satisfy overall performance requirements. Parametric studies of the influence of major structural characteristics on total system performance can be carried out rapidly using ideal optimized structures as bases of comparison. In the subsequent design of the selected configuration, the same principles of optimization can be utilized by the designer to achieve the optimum distribution of structural material at primary and detail design levels. Author

N71-13136# Technical Univ., Copenhagen (Denmark). Dept. of Applied Mechanics.
ON THE MINIMUM MASS LAYOUT OF TRUSSES
Pauli Pedersen *In* AGARD Symp. on Structural Optimization Oct. 1970 19 p refs (See N71-13126 03-32)
Avail: NTIS

The problem of finding the structure of minimum mass, given allowable stresses and fixed joints, is a linear programming problem and can be solved using the Simplex optimization technique. Normally, there is a number of solutions. A suitable formulation is obtained by formally allowing each member to carry simultaneously a tensile as well as a compressive force, i.e. by introducing twice the number of independent variables. When stability is taken into account, the allowable stress for a member in compression is a function of the compressive force. Therefore, the mass of the structure (the objective) will no longer be a linear function of the forces, and the Simplex technique cannot be used. However, a modified algorithm has been developed by which the solution is still obtainable. The problem is extended to find the best position of the joints. This is solved by an iterative procedure. For a given structure the partial derivatives of the mass with respect to possible displacements of the joints are calculated, and on the basis of this sensitivity analysis a better structure can be obtained. By successive iterations the loads due to the weight of the structure are also taken into account. Author

N71-13137# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
STRUCTURAL OPTIMIZATION OF A SUPERSONIC HORIZONTAL STABILIZER
J. R. Johnson and D. S. Warren *In* AGARD Symp. on Structural Optimization Oct. 1970 19 p refs Prepared in cooperation with Douglas Aircraft Co., Inc., Santa Monica, Calif. (See N71-13126 03-32)
Avail: NTIS

An existing computer program for structural optimization by gradient search techniques was modified to include an approximate constraint for flutter. The modified program was used to design a horizontal stabilizer for a supersonic aircraft. The idea of the flutter constraint was generalized to provide a family of criteria to account for flutter, divergence, and elastic stability in structural optimization. The criteria are function of displacements and therefore can be easily implemented, are economical to apply, and allow simultaneous optimization for strength and aeroelastic criteria. The stabilizer was first designed for strength using a fully stressed design criteria. The stabilizer was then redesigned with active strength and flutter constraints using the steepest descent and side step modes of the program. The results show a ten percent increase in weight to accommodate the flutter constraint, and local stiffening of the structure to increase the torsional frequency. Author

N71-13138# Fiat S.P.A., Turin (Italy).
OPTIMUM THERMOSTRUCTURAL DESIGN OF THIN CIRCULAR CYLINDERS
E. Vallerani *In* AGARD Symp. on Structural Optimization Oct. 1970 28 p refs (See N71-13126 03-32)

Avail: NTIS

Design charts are derived for the thermostructural design of thin, unstiffened, long circular cylinders subjected to typical loading and heating conditions. A thermostructural design index that includes all the structural design data and also the thermal design parameters is defined and related to a weight index through which the choice of the minimum weight structure can easily be accomplished. Several materials, typical for aerospace applications, have been analyzed with the proposed method and for a wide range of loading and heating conditions the optimum choice of the material has been evidentiated. Author

N71-13140# Leicester Univ. (England). Dept. of Engineering.
MAN-MACHINE INTERACTIVE STRUCTURAL ANALYSIS AS A PRELIMINARY-DESIGN AID
G. A. Butlin *In* AGARD Symp. on Structural Optimization Oct. 1970 26 p refs (See N71-13126 03-32)
Avail: NTIS

An interactive system is being developed to exploit the finite element method of structural analysis on a digital computer equipped with a cathode ray tube display screen. It has required the development of interactive graphics techniques, a system for spare matrix manipulation and a data structure and package of programs for generating and manipulating a digital model of an arbitrary configuration of finite elements. The design of the system and how it is operated is described along with details of the data structure and the packages of subroutines. Author

N71-13142# Case Western Reserve Univ., Cleveland, Ohio.
OPTIMIZATION OF STRUCTURES WITH RELIABILITY CONSTRAINTS
F. Moses *In* AGARD Symp. on Structural Optimization Oct. 1970 21 p refs (See N71-13126 03-32)
(Grants NSF GK-74; NSF GK-1871)
Avail: NTIS

The work surveys minimum weight design of structures using reliability or failure probability as the design constraint. Examples are illustrated from civil engineering structures as well as aircraft, heat shields and other aerospace problems. Some background material is given on computing failure probability from the frequency distributions of applied loads and strengths. Specific reliability based optima for multi-member systems are shown for weakest-link structures which fail if any element fails and redundant structures (fail-safe) designed for ultimate load conditions. The sensitivity of optimum design to reliability level as well as parameters in the reliability analysis is discussed. Mathematical programming methods suitable for reliability based optimization are presented. Author

N71-13143# Lockheed-California Co., Burbank.
THE OPTIMUM DESIGN OF SHELL STRUCTURE FOR STATIC STRENGTH, STIFFNESS, FATIGUE AND DAMAGE TOLERANCE STRENGTHS
Walter J. Crichlow *In* AGARD Symp. on Structural Optimization Oct. 1970 32 p refs (See N71-13126 03-32)
Avail: NTIS

Modern airframe structural design now involves accountability for: (1) static strength and stiffness of undamaged structure; (2) time to initiate fatigue cracks or the fatigue life of undamaged structure; (3) fracture toughness or residual static strength of damage structure; and (4) rate of crack propagation or the fatigue life of the damaged structure. The imposition of fatigue, fracture mechanics, and rate of crack propagation as new material characteristics, all highly sensitive to many environmental factors has extended the materials engineer's task of providing optimized materials and processing treatments and the structures engineer's task of designing for these phenomena. A systems approach to the design of airframe structure is described utilizing all of these material characteristics to achieve the level of structural integrity demanded of modern aircraft. Author

N71-13161# State Univ. of New York at Buffalo. Dept. of Engineering Science.
EFFECT OF RANDOM MATERIAL PARAMETERS ON NONLINEAR STEADY CREEP SOLUTIONS
F. A. Cozzarelli and W. N. Huang Aug. 1970 43 p refs
(Contract Nonr-4449(00); Grant NSF GK-1834)
(AD-712857) Avail: NTIS CSCL 20/12

An analysis is presented concerning the effect of random material parameters on nonlinear steady creep in a 3-bar truss. Parameter randomness is in general large and is introduced through randomness in the temperature and in the density of imperfections. Analytical and numerical results are presented on the statistical properties of the material parameters and of the stress and velocity. It is shown that randomness in the material parameters will on the one hand introduce only a very slight randomness in stress and on the other hand a very significant randomness in velocity. Author (TAB)

N71-13162# Illinois Univ., Urbana. Dept. of Civil Engineering.
NUMERICAL METHODS FOR THE ANALYSIS OF BUCKLING AND POSTBUCKLING BEHAVIOR OF ARCH STRUCTURES
John F. Harris and Arthur R. Robinson Sep. 1970 91 p refs *Its* Structural Res. Ser. No. 364
(Contract N00014-67-A-0305-0010)
(AD-712842) Avail: NTIS CSCL 13/13

The object of this study is to develop numerical methods for the analysis of structures having prebuckling configurations which are nonlinear functions of the loading parameter. A set of numerical procedures is presented for the simultaneous improvement of an approximate eigenvector and of an approximate location of a bifurcation point on the load-deflection curve. These methods include a technique for determining accurately the changes in the prebuckling configuration near bifurcation points. Multiple eigenvalues may be treated by a minor extension of the procedures. The new techniques may be regarded as modifications of the standard Newton-Raphson procedure. Experience indicates that the proposed methods are rapidly convergent and are economical of computational effort. The numerical procedures developed in this study are applied to buckling and postbuckling of arch members. Numerical results are presented for both in-plane and out-of-plane buckling of an initially planar arch. The results of these various analyses are in good agreement with certain of the previous solutions presented in the literature. Author (TAB)

N71-13187# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SOLUTION OF NONLINEAR PROBLEMS OF THE PLATE AND SHELL THEORY BY THE METHOD OF SMALL-STEP LOADING
D. I. Shiokrut 14 Aug. 1970 11 p refs Transl. into ENGLISH from Politekhnicheskii Inst., Kishinev. Trudy (USSR), no. 4, 1965 p 121-125
(AD-713043; FTD-HT-23-364-70) Avail: NTIS CSCL 20/11

With the described method the static loading of a nonlinear system is realized in small loading steps. Each new step is applied to the structure deformed by preceding loading steps, thus reducing the solution of nonlinear equations to that of linear equations. This method is known as the method of successive loadings or the step method. The solution (in general form) of the problem of the axisymmetric flexure of a circular plate with an initial manufacturing inaccuracy is presented as an illustration. Author (TAB)

N71-13198# Watervliet Arsenal, N.Y.
AN ENERGETIC APPROACH TO FATIGUE FAILURE
William P. Dunn May 1970 122 p refs
(AD-712890; WVT-7031) Avail: NTIS CSCL 20/12

Isothermal and adiabatic analyses have been made for both stress and strain controlled push-pull axial fatigue tests. An energy

criteria, postulated for fatigue failure, yields favorable comparisons between the results of analysis and experimentation; without the use of any posteriori fatigue data parameters being incorporated into the analysis. The approach of these analyses is then used to compute fatigue failure due to cumulative damage. Again, comparability between analytic and experimental results proves encouraging. Also, the conditions under which Miners law can be used for the computation of cumulative damage fatigue failure are explicitly set forth. As a result of the success of the above analyses, a generalized theory of fatigue failure is developed. Several problems are then analyzed using the general theory and the solutions compared to experimental results. This last set of studies ostensibly delineates several problem areas that will be encountered in future fatigue work; as well as problems that must be resolved before attempting more intricate fatigue analyses. Author (TAB)

N71-13227# Tokyo Univ. (Japan).
A METHOD OF MINIMUM WEIGHT DESIGN WITH REQUIREMENTS IMPOSED ON STRESSES AND NATURAL FREQUENCIES
Tetsuo Yasaka Jul. 1970 61 p refs
(ISAS-452-Vol-35-No-10) Avail: NTIS

A numerical method is presented to obtain the minimum weight design of structures whose stresses caused by several alternative loads and the first few natural frequencies are required to be within certain limits. The requirements may include other types of eigenvalues such as buckling loads. Thicknesses of panels and cross sectional areas of trusses are taken to be independent design variables, and geometrical configuration is assumed to be given. Finite element method is used for structural analysis. A simple procedure to obtain derivatives of eigenvalues with respect to the variables is first shown. The objective function, which is a sum of the weight and the penalty terms, is minimized using the derivatives. Steepest descent method is modified to speed up convergence. The method is applied to obtain optimum thickness of a plate beam, a two storied truss, and a simply supported beam. Author

N71-13228+ Lockheed Missiles and Space Co., Palo Alto, Calif.
SPECTRUM OF THE SYSTEM OF MEMBRANE EQUATIONS IN THE AXISYMMETRIC VIBRATIONS CASE FOR SHELLS OF REVOLUTION
V. B. Lidskii et al 1970 4 p refs Transl. into ENGLISH from Dokl. (USSR), v. 194, no. 4, 1970 p 786–789
Avail: NTIS

Given a set of axisymmetric vibration equations for shells of revolution, the functions u(s) and w(s) of the given equations are components of the displacement vector along the meridian and normal to the surface, and h is a small parameter. Zero approximations of the frequencies of the given equations are found by setting the small parameter h equal to zero, and a second order set of differential equations is derived in terms of L sub O. It is shown that the operator L sub O is symmetric and positive definite in the space of smooth vector functions f(s) satisfying the boundary conditions u(a) = u(b) = 0. R.B.

N71-13248# Newark Coll. of Engineering, N.J. Dept. of Mechanical Engineering.
DIGITAL COMPUTER PROGRAM FOR APPROXIMATE STRESS-CONCENTRATION ANALYSIS FOR A CYLINDRICAL BRANCH PIPE CONNECTION
Eugene Golub and Arnold Allentuch Aug. 1970 33 p refs
(Contract N00014-67-A-0225-0001)
(AD-712849; NCE-NV-3) Avail: NTIS CSCL 13/11

A computer program is presented which gives the total stress concentration factor caused by a branch pipe connection to a main pipe under internal pressure. The solution on which the program is based is obtained by an approximate method in which only bulk equilibrium and deformation requirements are maintained. The results are compared with available test data. The computer program is written for a General Electric 605 Time Sharing Computer. A complete listing of the program, including full documentation, is presented. In addition, a typical computer run is included. Author (TAB)

N71-13345# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumeahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE BUCKLING BEHAVIOR OF THIN-WALLED CIRCULAR CYLINDERS [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN DES BEULVERHALTENS DUENNWANDIGER UREISZYLINDER]
Maria Esslinger Jul. 1970 33 p refs In GERMAN; ENGLISH summary Presented at the Niedersaechsische Colloq. on Mech., Brunswick, 20 Jun. 1970
(DLR-MITT-70-10) Avail: NTIS; ZLDI Munich: 10 DM

An explanation is given for the sensibility of the buckling load of thin-walled shallow shells with respect to initial imperfections. For cylinders subjected to external pressure a lower limit of the scatter region of the buckling loads is calculated using postbuckling investigations for ideal cylinders. For axially loaded cylinders a calculation procedure is outlined which yields an estimation of the buckling load as function of measured or assumed initial imperfections. Author (ESRO)

N71-13346# Technische Hochschule Stuttgart (West Germany). Inst. fuer Umformtechnik.
A METHOD FOR THE APPROXIMATE CALCULATION OF THE STRESS-STRAIN STATE DURING RIGID PLASTIC MATERIAL FLOW [EIN VERFAHREN ZUR NAEHERUNGSWEISEN BERECHNUNG DES SPANNUNGS- UND FORMAENDERUNGSZUSTANDES BEIM FLIESSEN STARRPLASTISCHER WERKSTOFFE]
Gerhard Adler (Ph.D. Thesis) 1969 196 p refs In GERMAN Sponsored by Deut. Forschungsgemeinschaft
(Rept-12) Avail: NTIS

The least squares principle is used to develop a general method for the solution of partial differential equations in arbitrary boundary value problems. This method is applied to metal drawing processes to determine the forces exerted on the drawing tools, the strain distribution in the material after deformation, and the heat generation. The computer program developed for this purpose can be applied to any kind of deformation process by defining the applicable boundary conditions. ESRO

N71-13350# Technische Hochschule Darmstadt (West Germany). Fakultaet fuer Bauingenieurwesen.
THEORETICAL AND EXPERIMENTAL DETERMINATION OF LOADS ON ECCENTRICALLY PRESSED COLUMNS, ESPECIALLY THOSE WITH DIFFERENT BUT SECTION-WISE CONSTANT CROSS-SECTION VALUES [BEITRAG ZUR RECHNERISCHEN UND VERSUCHSMAESSIGEN BESTIMMUNG VON TRAGLASTEN FUER EXZENTRISCH GEDRUECKTE STAEBE, INSBESONDERE VON SOLCHEN MIT UNTERSCHIEDLICHEN, ABER ABSCHNITTSWEISE KONSTANTEN QUERSCHNITTSWERTEN]
Gerhard Voelkel (Ph.D. Thesis) 1970 105 p refs In GERMAN
Avail: NTIS

The critical values for columns subjected to eccentric loads are determined for arbitrary stress-strain relations, taking into account the nonlinear differential equation for bending processes. The curves of internal resistance and the bending lines are also determined. In particular, the influence of steps in cross sectional areas is of interest. Computer calculations are checked against a number of loading experiments. ESRO

N71-13351# Oxford Univ. (England). Engineering Lab.
OPTIMUM DESIGN OF CIRCULAR SANDWICH PLATES
W. S. Hemp Oct. 1970 17 p ref

(Rept-1120/70) Avail: NTIS

This optimization may be reduced to the Lagrangian problem in the calculus of variations and resolved by standard techniques. The dual problem is derived and the solutions give the true minima. Solutions of plate problems with edges simply supported, free and clamped and loaded by uniform pressure and by concentrated loads are given. Author (ESRO)

N71-13353# Technische Hochschule Darmstadt (West Germany). Inst. fuer Werkstoffkunde.

ELECTRICAL MAGNETIC AND MECHANICAL MEASUREMENTS FOR INVESTIGATION OF STRUCTURAL CHANGES IN MATERIALS UNDER TIME-DEPENDENT LOADS [ELEKTRISCHE, MAGNETISCHE UND MECHANISCHE MESSUNGEN ZUR BEURTEILUNG VON WERKSTOFFVERAENDERUNGEN UNTER ZEITSTANDBEANSPRUCHUNG]

Joachim Scholz (Ph.D. Thesis) 1970 157 p refs In GERMAN Avail: NTIS

The relation between electric and magnetic properties of ferritic steels and the creep testing of these materials are discussed. Tests are carried out to investigate effects of changes in mechanical properties due to annealing and creep tests. ESRO

N71-13385# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STATISTICAL ISOTROPIC DEFORMATION OF COMPOSITE MATERIALS

G. M. Savin et al 17 Jul. 1970 10 p refs Transl. into ENGLISH from Dopov. Akad. Nauk Ukr. RSR, Ser. A (Kiev), v. 29, no. 9, 1967 p 804-809

(AD-712814; FTD-HC-23-198-70) Avail: NTIS CSCL 20/11

The paper deals with the determination of macroscopic moduli, dispersion and correlative moments of deformation for an elastic solid with random heterogeneity under homogeneous loading. A generalized definition is deduced of a statistically isotropic tensorial field of random deformation for the case when first moments of the deformation are not to equal to zero. On this basis the problem is reduced to a solution of an infinite system of equations for the corresponding one-point moments. Author (TAB)

N71-13386# Naval Underwater Systems Center, New London, Conn.

THEORETICAL CONSIDERATIONS FOR SUPPORTING COMPOSITE BEAMS AND CIRCULAR PLATES UNDERGOING FLEXURAL VIBRATIONS

Charles LeBlanc 30 Jul. 1970 58 p refs

(AD-712765; NUSC/NL-3022) Avail: NTIS CSCL 20/11

Flexural vibrators, in the form of beams or circular plates, have been proposed as a means of achieving relatively small, low-frequency sonar transducer elements. The original designs were based on symmetric bilaminar elements composed of polarized ferroelectric ceramic material. Later designs used a symmetric trilaminar configuration with active ceramic bounding a center lamination of inactive material. More recently, however, several designers have advocated the use of bilaminar (ceramic-metal) configurations in order to increase the depth capability of flexural vibrators without using internal pressure compensation for the hydrostatic loading. This report investigates and explains some of the implications involved in physically supporting these designs from a viewpoint of defining a neutral surface (plane) in any particular structure. The results indicate that some configurations have true planes at which supports may be attached, whereas the neutral plane for other configurations is not explicitly defined but may be approximated. The dynamic equations of equilibrium are derived for some of the cases that are considered, and similar equations for the other cases can be inferred from the derived equations when certain conditions are satisfied. Author (TAB)

N71-13389# Watervliet Arsenal, N.Y. Benet R and E Labs.

SOME PROBLEMS OF NONLINEAR STRESS WAVES IN SOLIDS

Yun K. Huang Jul. 1970 19 p refs

(AD-712991; WVT-7039) Avail: NTIS CSCL 20/11

The paper considers some fundamental aspects of dynamic loading as produced in a solid by contact explosion or ballistic impact. At such high stress and strain rates, a quasi-static constitutive relation may be used in the formulation of the nonlinear wave equation for the solid with both rigidity and compressibility taken into account. The formalism of the hyperbolic-type wave equation can serve to disclose several fundamental properties of nonlinear stress waves in solids. It is of interest to note that both elastic shock waves and plastic shock waves can exist in tension as well as in compression. For very strong compression the effect of material strength may be neglected, and only plastic shocks become identical with hydrodynamic shocks. Four nonlinear solids are examined in connection with plane waves based on Lagrangian coordinates, and a compact wave equation is presented to cover several simple geometries. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N71-12280*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A COMPARISON OF TWO TRANSIENT METHODS OF MEASURING THERMAL CONDUCTIVITY OF PARTICULATE SAMPLES

Ronald W. Scott and James A. Fountain 29 Sep. 1970 29 p refs

(NASA-TM-X-64559) Avail: NTIS CSCL 20M

A comparison is made of two transient methods of measuring thermal conductivity of particulate media in vacuum. The comparison is based on the following criteria: (1) apparatus required, (2) pretest requirements, (3) data reduction procedures, (4) time comparison, (5) heater voltage effects, and (6) comparison of test results. It is concluded that the differentiated line source method gives results comparable to the established line source method and is much easier and faster (by an order of magnitude) to employ. Author

N71-12887# California Univ., Livermore. Lawrence Radiation Lab.

SHOCK INITIATION OF LX-07-2 AND LX-10-0

Leroy G. Green, Richard J. Wasley, and Paul E. Kramer 10 Apr. 1970 6 p refs

(UCRL-50851) Avail: NTIS

Shock initiation experiments were conducted on LX-07-2 and LX-10-0 using the wedge and Snowball techniques. Excess transit times (XSTT) were determined as a function of initiating pressure. Using XSTT as a criterion, both LX-07-2 and LX-10-0 were found to be similar in shock sensitivity to LX-09-0. Author (NSA)

N71-12888# Iowa State Univ. of Science and Technology, Ames.

THERMAL STUDY OF ABSOLUTE IONIC ENTROPIES AND CRYSTAL FIELD SPLITTINGS IN HEAVY RARE EARTH TRICHLOROHEXAHYDRATES. HEAT CAPACITIES FROM 5-300 DEG K

F. H. Spedding, D. C. Ruff, and B. C. Gerstein [1970] 11 p refs Presented at the Rare Earth Res. Conf., Reno, Nev., 19-22

Apr. 1970 Sponsored by AEC
(CONF-700403-7) Avail: NTIS

Heat capacity measurements were made from 5-300 K on the hexahydrated trichlorides of Gd, Tb, Ho, and Lu. The lattice contributions to the heat capacity of the magnetic salts were obtained utilizing an interpolation between the Gd and the Lu salt. Subsequently determined crystal field splittings of the lowest J level were obtained for the Tb and Ho salts. These splittings were compared with optical spectral data. The absolute ionic entropies of the ions of the above salts in solution were determined using the present measurements and previous data from solution calorimetry. Author

N71-12960*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DEVELOPMENT OF TECHNIQUES AND ASSOCIATED INSTRUMENTATION FOR HIGH TEMPERATURE EMISSIVITY MEASUREMENTS, APPENDIX A, BIBLIOGRAPHY, VOLUME 2 Quarterly Progress Report, 29 Jun. -30 Sep. 1970
30 Sep. 1970 121 p refs
(Contract NAS8-26304)
(NASA-CR-102934; QPR-1) Avail: NTIS CSCL 20M

This appended bibliography contains references and abstracts pertinent to the subject of emittance of high temperature materials. Characteristics of refractory and other high temperature metals and alloys, ceramics and high temperature coating materials, carbon, graphites, ablative materials, and chars are reported. Additional qualifing modifiers include reentry vehicles, heat shields, radiant heat transfer in hypersonic flows, measurement methods and reentry simulation. E.M.C.

N71-12993# Institute of Technology, Helsinki (Finland). Dept. of Technical Physics.
CALORIMETRIC DETERMINATION OF NUCLEAR AND ELECTRONIC INTERACTIONS IN METALS Final Scientific Report, 1 Jan. 1969 - 30 Jun. 1970
Olli V. Lounasmaa 31 Jul. 1970 6 p refs
(Contract EOOAR-0054-69)
(AD-712095; AFOSR-70-2399TR) Avail: NTIS CSCL 20/13

The number of measurements made in the period covered by this report has been considerable; their scope is indicated by the list of published and forthcoming papers appended below. A wide range of ultralow temperature phenomena have been investigated mainly through measurements of nuclear heat capacities. Of the more interesting of these are experiments on bismuth, rhenium, and praseodynium. Author (TAB)

N71-12994# Scientific Translation Service, Ann Arbor, Mich.
ENERGY ACCUMULATION IN THE PACKING OF A REGENERATOR
Tadeusz Bes Jun. 1970 18 p refs Transl. into ENGLISH from the POLISH Prepared for Argonne Natl. Lab.
(ANL-TRANS-836) Avail: NTIS

The paper discusses the computation of the capacity of energy accumulation in the filling of a heat regenerator. It was assumed that: (1) The form of the filling is optional. (2) The temperature of the gas flowing past the filling changes within one cycle according to any function of alternate theta(f) and alternate theta(f*). The symbols without asterisks denote the heating phase, those with asterisks the cooling phase. (3) The Biot numbers, (Bi) and (Bi)* may differ and change with the time f and f*. Author (NSA)

N71-13035*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SURVEY OF HEAT TRANSFER TO NEAR-CRITICAL FLUIDS
Robert C. Hendricks, Robert J. Simoneau, and Ray V. Smith Washington Nov. 1970 116 p refs
(NASA-TN-D-5886; E-5084) Avail: NTIS CSCL 20M

A survey of near-critical heat transfer was made including the following areas: thermal properties, heat transfer boundaries of the near-critical region, free, natural, and forced convection experiments, oscillations, geometric effects, parameters which appear to be significant to heat transfer in the critical region, and theories which were proposed for the region. The state of the art is such that completely satisfactory theories or correlations are not available for heat transfer in the critical region. However, the most promising and widely used correlations and procedures for approaching a critical point heat transfer problem are indicated. Author

N71-13038*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INTEGRAL ANALYSIS OF HEAT TRANSFER DOWNSTREAM OF A REARWARD-FACING STEP WITH SMALL COOLANT INJECTION
Keiichi Karashima Washington Dec. 1970 84 p refs
(NASA-TN-D-5970; L-6689) Avail: NTIS CSCL 20M

Slot cooling is analyzed theoretically for the case where the approaching boundary layer is thin, relative to the slot height, and the coolant flow rate is small. The analysis treats the turbulent mixing layer, the recompression region, and the turbulent boundary layer downstream of the slot. The analysis shows that coolant injection reduces total heating downstream of the slot whereas local heating in the jet mixing and recompression regions may increase. Author

N71-13099# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
HYBRID COMBUSTION WITH SURFACE PYROLYSIS
Satoaki Omori (Ph.D. Thesis, 25 Dec. 1969) Jun. 1970 39 p refs
(ISAS-450-Vol-35-No-8) Avail: NTIS

The gas dynamical aspects of combustion in hybrid rocket motors are considered. The model used is the two-dimensional steady laminar boundary layer with fuel injection from the fuel surface and chemical reaction in the gas phase. It is also shown that combustion occurs in the boundary layer even in practical hybrid rocket motors. The boundary layer flow with complicated boundary conditions is treated by the Rayleigh analogy. The characteristic time for evaporation or sublimation of the fuel from the fuel surface is assumed to be finite and comparable in magnitude with the time for the fuel to diffuse across the boundary layer or for the heat to be transferred from the flame to the fuel surface; heat transfer and diffusion times are of the same order of magnitude, when the Lewis number is of the order of unity. The fuel surface is necessarily in nonequilibrium, and the surface temperature is neither constant nor prescribed along the fuel surface: it is calculated self-consistently. The result of the calculation shows that surface combustion occurs near the leading edge due to the cooling effect of the incoming oxidizer. Also, the profiles of the temperature, mass-fractions and velocity, the location of the flame sheet, the point of flame detachment, and the fuel regression rate are shown. Author

N71-13225# Bureau of Mines, Pittsburgh, Pa. Safety Research Center.
RECOMMENDATION OF FLASH POINT METHOD FOR EVALUATION OF FLAMMABILITY HAZARD IN THE TRANSPORTATION OF FLAMMABLE LIQUIDS Final Report
Joseph M. Kuchta and David Burgess 29 Apr. 1970 18 p refs
(Contract DOT-OS-00007)
(PB-193077; SRC-S-4131) Avail: NTIS CSCL 13L

The report consists of recommendations, with supporting data and reasoning, for use of the Tagliabue (Tag) closed cup method to determine the flash points of flammable liquids for transportation hazard classification purposes. It presents comparative data for Tag open cup and Tag closed cup flash points and for Tag closed cup values and those calculated from lower flammable limits. It compares repeatability and reproducibility of several types

of testers. The behavior of mixtures is treated along with that of near liquids. The report does not include a separate bibliography, but does cite a number of significant references. Author (USGRDR)

N71-13226# Sandia Corp., Albuquerque, N.Mex. Technical Translation Service.
ON THE CONDUCTION OF HEAT [SULLA CONDUZIONE DEL CALORE]
Carlo Cattaneo 16 Jul. 1970 30 p Transl. into ENGLISH from Modena Univ. Seminar. Mat. e Fis. (Atti), v. 3, 1948 p 83-101
(PB-193263T; SC-T-70-4029) Avail: NTIS CSCL 20M

The present paper reproduces several considerations, expounded during a session of the Mathematical Seminar of the University of Rome, in May 1946, dealing with a paradoxical aspect inherent in the classical theory of heat propagation. USGRDR

N71-13249 Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE THERMODYNAMICS OF SYSTEMS OF DIRECT CONVERSION OF THERMAL INTO ELECTRICAL ENERGY
V. A. Grodko et al [1970] 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 4, 1970 p 117-126
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Relations describing the general characteristics of a system performing direct conversion of thermal energy into electrical are derived by thermodynamic analysis. It is shown that in particular cases the relations result in the known equations for characteristics of thermoelectric and thermoemission converters, as well as in regularities underlying the operation of these apparatus, the relations which determine the thermoelectric phenomena, the Richardson equation, etc. A thermodynamic cycle is proposed whose quantitative characteristics are identical, under the assumptions customary for an ideal cycle, to the characteristics of a direct conversion system in both the general and particular cases. Author

N71-13372# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Luftsaugende Antriebe.
FORTRAN PROGRAM FOR THE CALCULATION OF THE VARIABLES OF STATE OF REAL GAS MIXTURES WITH APPLICATIONS [FORTRAN-PROGRAMM ZUR BESTIMMUNG DER ZUSTANDSGROESSEN VON REALEN GASGEMISCHEN MIT ANWENDUNGSBEISPIELEN]
Guenter Dahl Dec. 1969 54 p refs In GERMAN; ENGLISH summary
(DLR-MITT-69-27) Avail: NTIS; ZLDI Munich: 11.50 DM

A FORTRAN program NTIS; the equilibrium composition of gas mixtures as a function of pressure and temperature is developed. The required thermodynamic properties of the reaction components are listed from 0 to 6000 K in steps of 100 K, so that the dissociation as the only result of the real gas effect is considered. Depending on these properties and the computed moles the enthalpy and entropy are calculated. The application of the program is shown by a calculation of enthalpy-entropy diagrams for air and for exhaust gas of a hydrocarbon (C7H14) air combustion with and without dissociation. Author (ESRO)

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N71-12424*# National Aeronautics and Space Administration, Washington, D.C.
US PATENTS FOR NASA INVENTIONS: AVAILABLE FOR LICENSING IN THE UNITED STATES
[1970] 13 p
(NASA-TM-X-66495) Avail: NTIS CSCL 05A

Several thousand inventions result each year from the aeronautical and space research supported by NASA. The inventions cover various fields of technology and many of them have potential commercial application. Those inventions having important use in Government programs or significant commercial potential are patented by NASA. Application procedures are provided for patent licenses and a list of patents available for licensing is given. Author

N71-12727# Gesellschaft fuer Weltraumforschung m.b.H., Bad Godesberg (West Germany).
COSTS OF SATELLITE TESTING [TESTKOSTEN VON SATELLITENPROJEKTEN]
Ants Kutzer *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 3 1970 32 p refs In GERMAN (See N71-12719 03-11)
Avail: NTIS

The philosophy behind a test program is described in terms of statistical reliability. A survey is given of the test program itself and the costs involved for the Azur satellite. Finally, the total costs of the installation for the acceptance and qualification program for Azur are given. ESRO

N71-12735*# George Washington Univ., Washington, D.C. Medical Center.
POTENTIAL FOR APPLICATION OF NASA TECHNOLOGY TO SOLID WASTE PROBLEMS IDENTIFIED BY THE DIVISION OF SOLID WASTE, BUREAU OF MINES
Nov. 1970 54 p refs
(Contract NASw-2055)
(NASA-CR-111610) Avail: NTIS CSCL 13B

A description of the activities of the Bureau of Mines Solid Waste Division is described in sufficient detail so that NASA's Office of Technology Utilization can determine whether or not NASA technology has application to Division of Solid Waste environmental problems. This discussion includes comments on the state of the art relative to the solution of the problems encountered by the Division of Solid Waste. Author

N71-12760# TRW Systems, Redondo Beach, Calif.
SUPPORTING STUDIES FOR HSGT SYSTEM REPORTS Final Report
Jun. 1970 522 p refs
(Contract DOT-353-66)
(PB-193144; TRW-06816-6041-R0-00) Avail: NTIS CSCL 13F

The development and characteristics of high speed ground transportation systems are discussed. Appendices covering various detailed analyses on a high speed rail system, tracked air cushion vehicle systems, multimodal systems, and automated highway systems are presented. Author

N71-12963# National Aerospace Lab., Amsterdam (Netherlands). Research Commission.
FOUNDATION OF THE NATIONAL AEROSPACE LABORATORY Annual Report, 1969 [STICHTING NATIONAAL LUCHT-EN RUIMTEVAARTLABORATORIUM, VERSLAG OVER HET JAAR 1969]
1969 96 p refs In DUTCH; ENGLISH summary
Avail: NTIS

Described are organizational and economic aspects of the foundation as well as national and international activities. Research work centers on operational radar guidance for airports, aerodynamic wind tunnel evaluations in airplane developments, electron microscopic analyses on construction materials, mechanical

engineering for aircraft structures; space flight, and studies of various intrastructural processes. Technical equipment is also briefly described. Transl. by G.G.

N71-13007# Daresbury Nuclear Physics Lab. (England).
EXPERIMENTAL PHYSICS, THEORETICAL PHYSICS, PHYSICS APPARATUS AND MEASUREMENTS, COMPUTING AND ELECTRONICS, AND ELECTRON SYNCHROTRON OPERATION AND DEVELOPMENT Annual Report, 1969
[1969] 115 p refs
(NP-18316) Avail: AEC Depository Libraries

Details are given of the organization of the laboratory and work carried out. The information is presented under the following headings: experimental physics; theoretical physics; physics apparatus and measurements; computing and electronics; electron synchrotron, operation and development; machine physics; electron synchrotron, new developments; engineering; administration; and a list of publications. NSA

N71-13038# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 239
28 Oct. 1970 102 p Transl. into ENGLISH from Russian reports (JPRS-51657) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1–7 (See N71-13039 03-30)
2. METEOROLOGY p 8–31 (See N71-13040 03-20)
3. OCEANOGRAPHY p 32–45 (See N71-13041 03-13)
4. TERRESTRIAL GEOPHYSICS p 46–56 (See N71-13042 03-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 57–76 (See N71-13043 03-30)
6. TASS GIVES DETAILED REPORT ON FLIGHT OF DELTA LUNA 16, APPENDIX p 78–92 (See N71-13044 03-31)

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA deposits its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers located in the organizations listed below. Each center is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

CALIFORNIA
University of California, Berkeley

COLORADO
University of Colorado, Boulder

DISTRICT OF COLUMBIA
Library of Congress

GEORGIA
Georgia Institute of Technology, Atlanta

ILLINOIS
The John Crerar Library, Chicago

MASSACHUSETTS
Massachusetts Institute of Technology, Cambridge

MISSOURI
Linda Hall Library, Kansas City

NEW YORK
Columbia University, New York

PENNSYLVANIA
Carnegie Library of Pittsburgh

TEXAS
Southern Methodist University, Dallas

WASHINGTON
University of Washington, Seattle

NASA publications (those indicated by an "*" following the accession number) are also received by the following public and free libraries:

CALIFORNIA
Los Angeles Public Library
San Diego Public Library

COLORADO
Denver Public Library

CONNECTICUT
Hartford Public Library

DELAWARE
Wilmington Institute Free Library, Wilmington

MARYLAND
Enoch Pratt Free Library, Baltimore

MASSACHUSETTS
Boston Public Library

MICHIGAN
Detroit Public Library

MINNESOTA
Minneapolis Public Library
James Jerome Hill Reference Library, St. Paul

MISSOURI
Kansas City Public Library
St. Louis Public Library

NEW JERSEY
Trenton Public Library

NEW YORK
Brooklyn Public Library
Buffalo and Erie County Public Library
Rochester Public Library
New York Public Library

OHIO
Akron Public Library
Cincinnati Public Library
Cleveland Public Library
Dayton Public Library
Toledo Public Library

OKLAHOMA
Oklahoma County Libraries, Oklahoma City

TENNESSEE
Cossitt-Goodwin Libraries, Memphis

TEXAS
Dallas Public Library
Fort Worth Public Library

WASHINGTON
Seattle Public Library

WISCONSIN
Milwaukee Public Library

An extensive collection of NASA and NASA-sponsored documents and aerospace publications available to the public for reference purposes is maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York, 10017.

EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the National Lending Library for Science and Technology, Boston Spa, Yorkshire, England. By virtue of arrangements other than with NASA, the National Lending Library also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from: ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av de Neuilly, 92-Neuilly-sur-Seine, France.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546
OFFICIAL BUSINESS

FIRST CLASS MAIL

POSTAGE AND FEE
NATIONAL AERONAU
SPACE ADMINISTRA

01U 001 01 53 5FU 71028 01386
DUKE UNIVERSITY LIBRARY
PUBLIC DOCUMENTS DIVISION
DURHAM, NORTH CAROLINA 27706

ATT DOCUMENTS LIBRARIAN

POSTMASTER: If Undeliverable (S
Postal Manual) Do

NEW NASA PUBLICATIONS

This Island Earth (NASA SP–250)

"We do not realize what we have on Earth until we leave it."

This remark by Astronaut James Lovell is one theme of a striking new book just released by the NASA Scientific and Technical Information Office. *This Island Earth* contains many large color reproductions of photographs of Earth taken during Apollo and other U.S. space flights. Many of the pictures have not previously been widely seen.

The preface of the book states that one purpose is to reflect "a sobering realization of man's place in the universe." In the foreword, NASA Acting Administrator George M. Low writes that "Photographs such as this book contains increase our understanding of the relationships between our activities and our environment. It is somewhat paradoxical that man's new ability to voyage in space has provided him with a valuable way to appreciate his Earth."

Chapters in the book reflect its viewpoint: Near a Star Called Sun; The Restless Atmosphere; The Waters of Earth; The Lands of Earth; The Hand of Man; Across North America; and Beyond This Island Earth.

The large-format book was edited by Oran W. Nicks, presently Deputy Director of the Langley Research Center, who has previously held senior NASA posts in lunar and planetary programs, space science and applications, and advanced research and technology. A number of scientists and engineers, both within NASA and elsewhere, collaborated with Nicks in preparing text and captions and in selecting the photographs. *Clothbound.* 192 pp. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $6.00.

Scientific and Technical Information Office
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D. C. 20546